ARCHITECTURE DEPARTMENT

MASTER OF ARCHITECTURE PROGRAMME

CHINESE UNIVERSITY OF HONG KONG

2010-2011 DESIGN REPORT

ONE-ROOM COMPACT LIVING: APROPSAL ON NEW PROTOTYPE OF HONG KONG PUBLIC HOUSING TOWER AND TRANSFORMATION OF INDUSTRIAL BUILDING IN TO RESIDENTIAL USE

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ONE-ROOM COMPACT LIVING

A proposal on new prototype of Hong Kong Public Housing tower and transformation of industrial building into residential use

Thesis Report I

1. Study of Hong Kong Public Housing and Unit Types
2. Study of Detailed Unit Plan
3. Precedent Studies of compact living
4. Design strategy extracted from researches
5. Site selection

Thesis Report II

6. Site Study - Fo Tan Industrial Area
   Building Study - Unison Industrial Centre
7. Case Study - Prefabrication Building System
8. Design Testing - Size of unit
9. Mass study and Typology
10. Design proposal - Layout and Units
11. Thesis Essay

ONE-ROOM COMPACT LIVING

The thesis is trying to design one-room compact living space in response to unique condition where density is experienced every day in Hong Kong. The idea of single-roomed space can be found in early public housing. The units are small but flexible in use and adaptable to habitants' needs. This thesis questions how big we need for living, how enjoyable we can even living in small home.

RESEARCHES

The first part of researches is to study public housing in Hong Kong, which have been shown how compact the living space it is and how inhabitants were trying to cope with the situation. The strategies coping with limited space are:-

- Use of rather large-sized furniture as space defining elements
- Use of mutli-proposed furniture
- Use of foldable furniture

The second part of researches is to study other international cases with similar problem in handling limited living space.
The design strategies for housing units retrieved from the researches are:-

- Higher net floor height for creating loft space
- Make use of space above kitchen and washroom
- Ideas of suitcase house with folding, sliding elements for transformation of use

DESIGN STRATEGY

- One-room living space

To design the envelope of unit and let habitants to decide internal spatial organization

- Higher net floor height

To propose net floor height >3m instead of current standard 2.3m for creating mezzanine floor if needed

- Unit volume

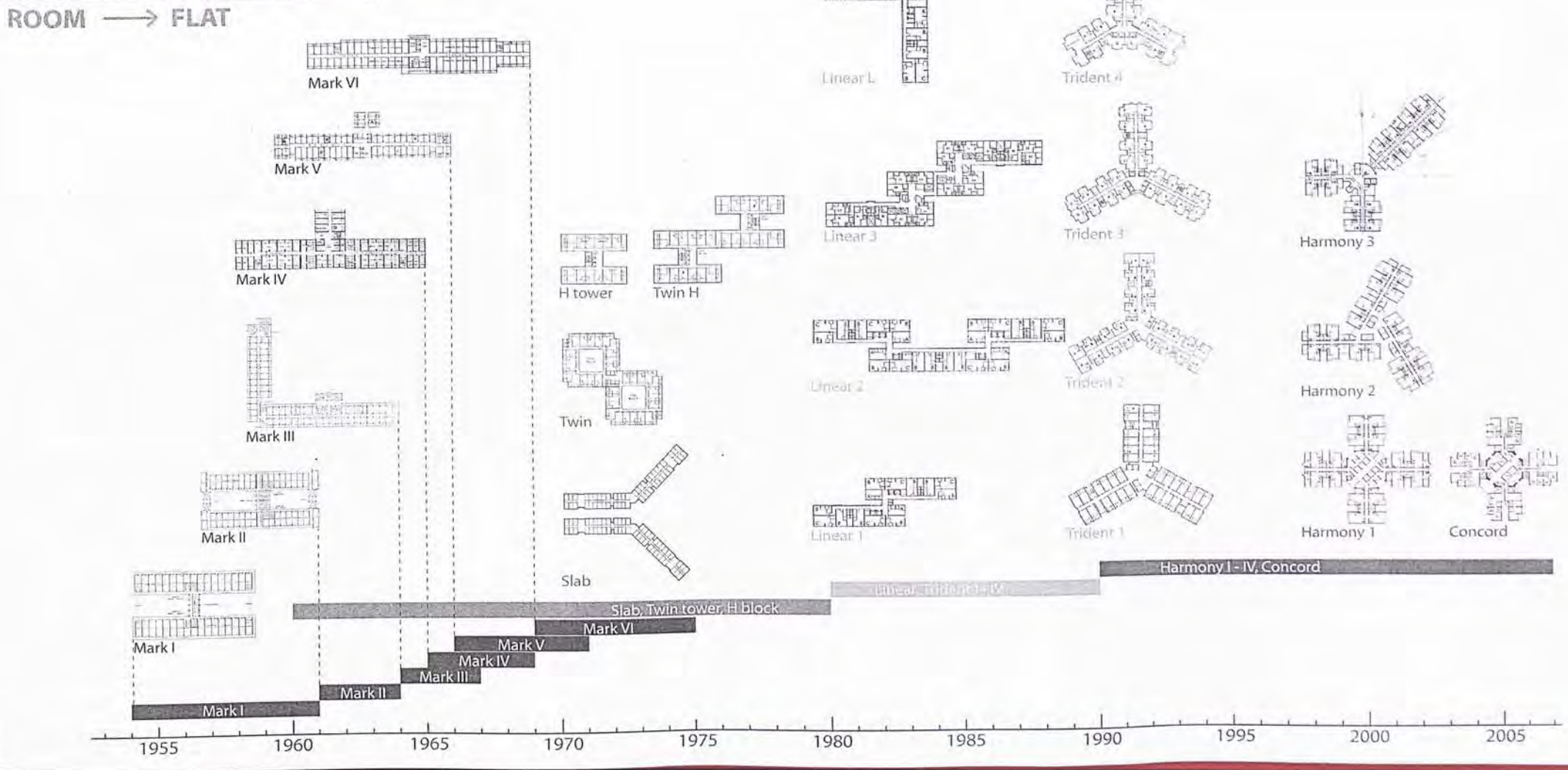
To consider planar (floor area) and also sectional (floor height) development as a whole

SITE

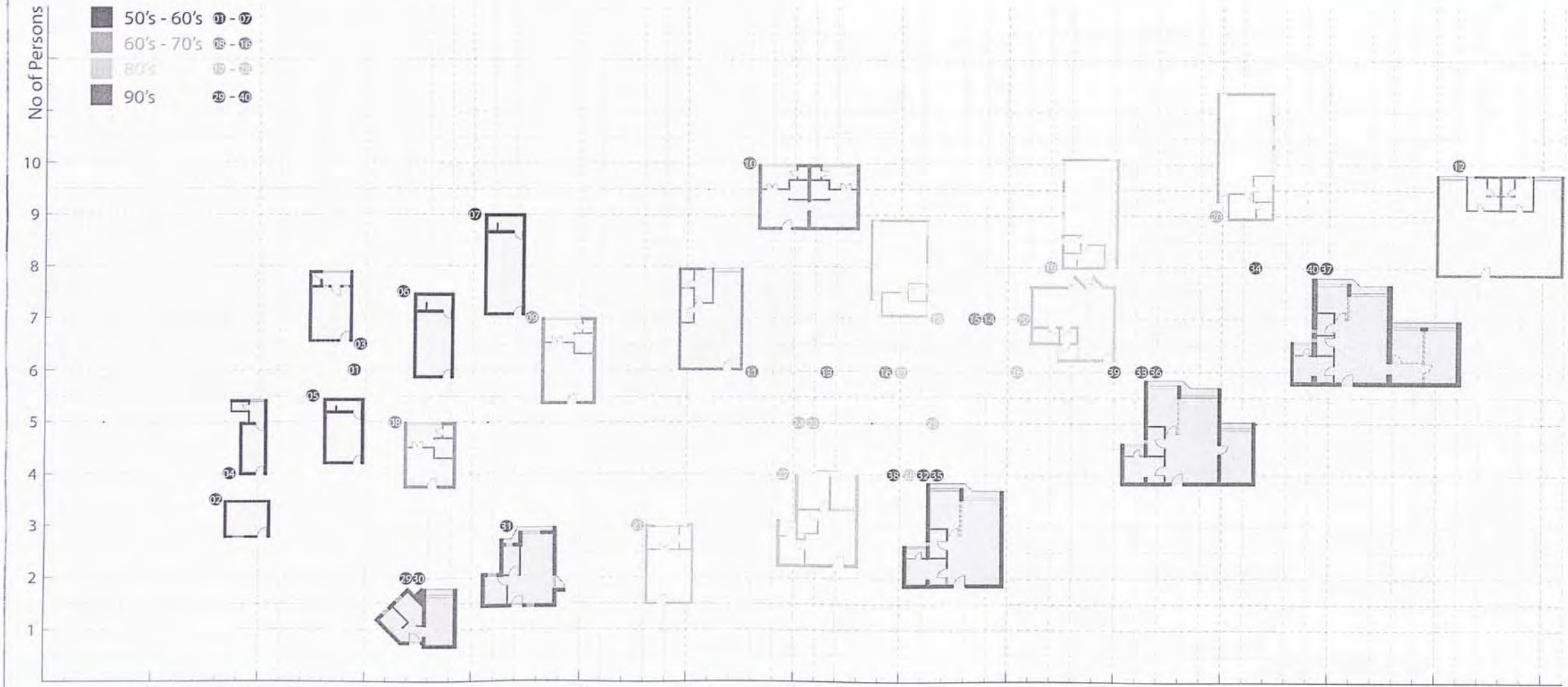
Industrial building will be selected as an experimental site to testify the hypothesis of this study as this type of building usually has a rather higher net floor height. In current situation in Hong Kong, lower net floor height seems a key to increase space efficiency. But it is not the best way rather decreases the area of space we can use. A better way is proposed by increasing the floor height to more that 3m so that loft area can be created, which learning from the old days, making hanging beds etc. Therefore, space efficiency can be increased.

THESIS ABSTRACT

.1 Timeline of Hong Kong Public Housing

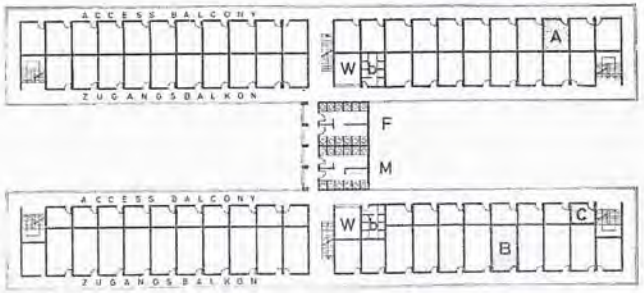


1.2 Study of Density over the years and types



3 Study of housing typs and units in each types

Mark I scale 1 : 500



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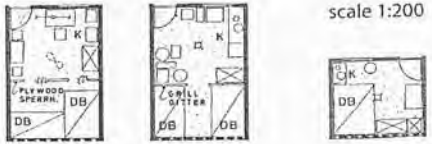
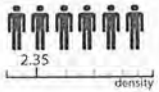


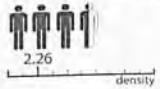
01 Flat B

14.10m²



02 Flat C

8.00m²

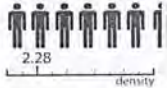


Mark IV scale 1:500

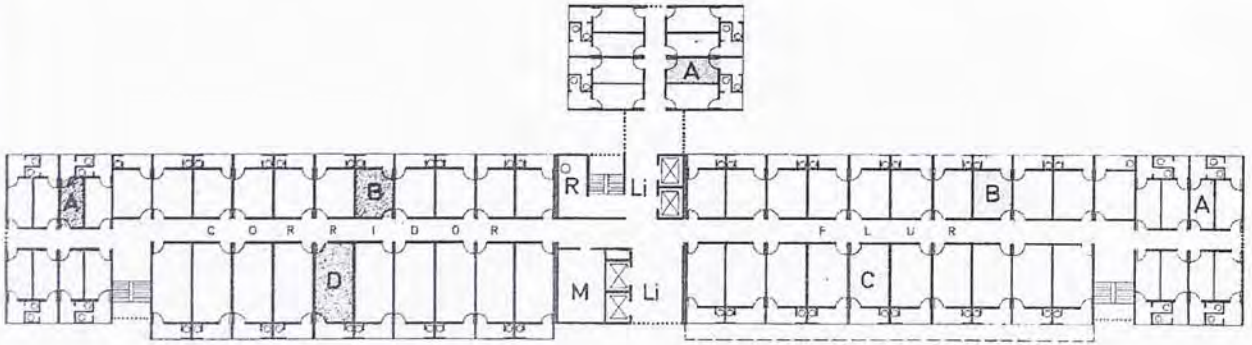
scale 1:200

03

14.80m²



Mark V scale 1:500



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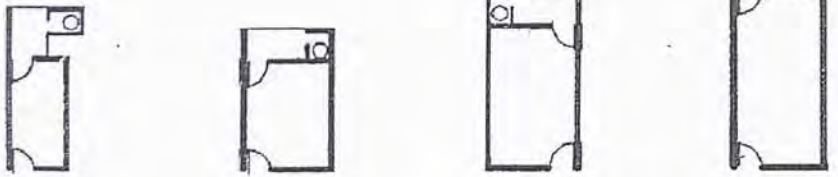


㉔ Flat A 8.90m²

2.23 density

㉕ Flat B 12.50m²

2.27 density

㉖ Flat C 16.70m²

2.23 density

㉗ Flat D 20.00m²

2.22 density

Old slab scale 1:500

scale 1:200

⑫ Flat A 16.34m²

3.27 density

⑪ Flat B 22.79m²

3.26 density

⑩ Flat C 32.89m²

3.29 density

New slab scale 1:500

scale 1:200

Flat A

33.04m²

5.51

density

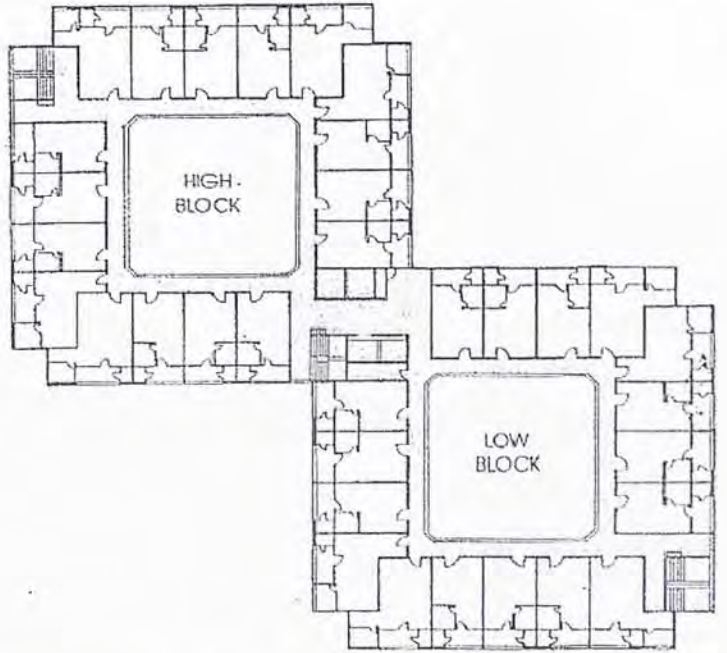
Flat D

66.08m²

6.61

density

Twin tower scale 1:500



scale 1:200

Flat B

36.45m²

6.08

density

Flat C

4.18m²

6.31

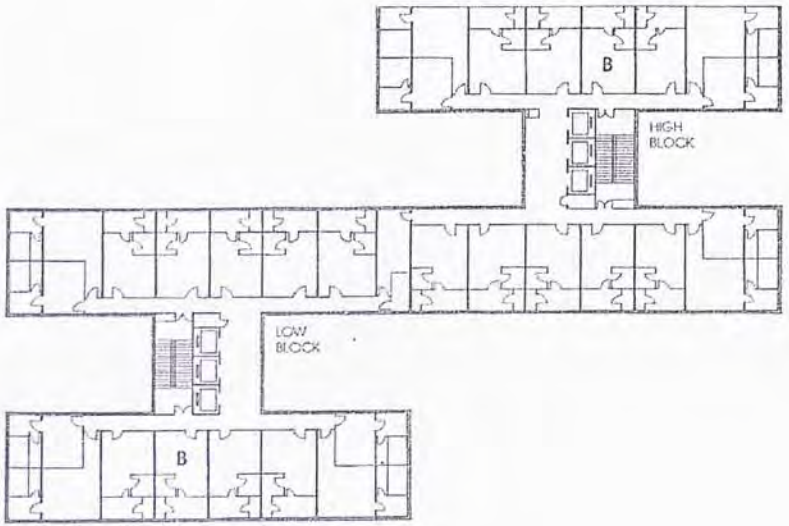
density

Flat C1

3.59m²

density

H tower scale 1:500



scale 1:200

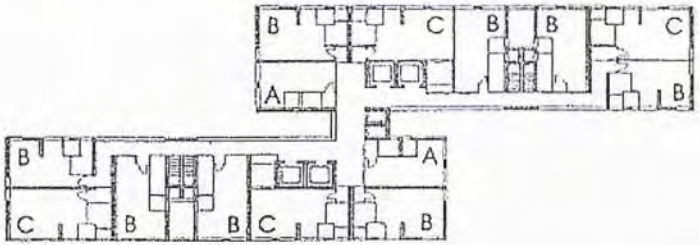
⑯ Flat B

39.24m²

6.54

density

Linear L1 scale 1:500



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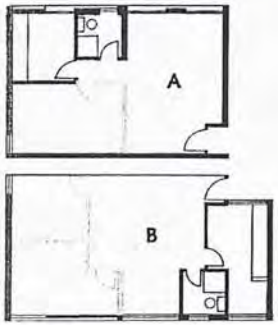
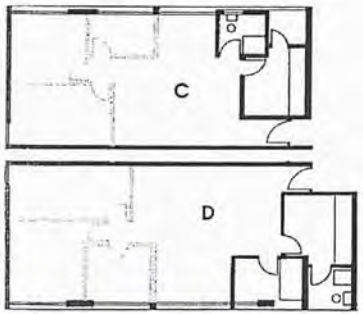




⑰ Flat A

35.96m²

5.99

density

⑱ Flat C

.04m²

5.88

density

⑲ Flat B

41.84m²

5.99

density

⑳ Flat D

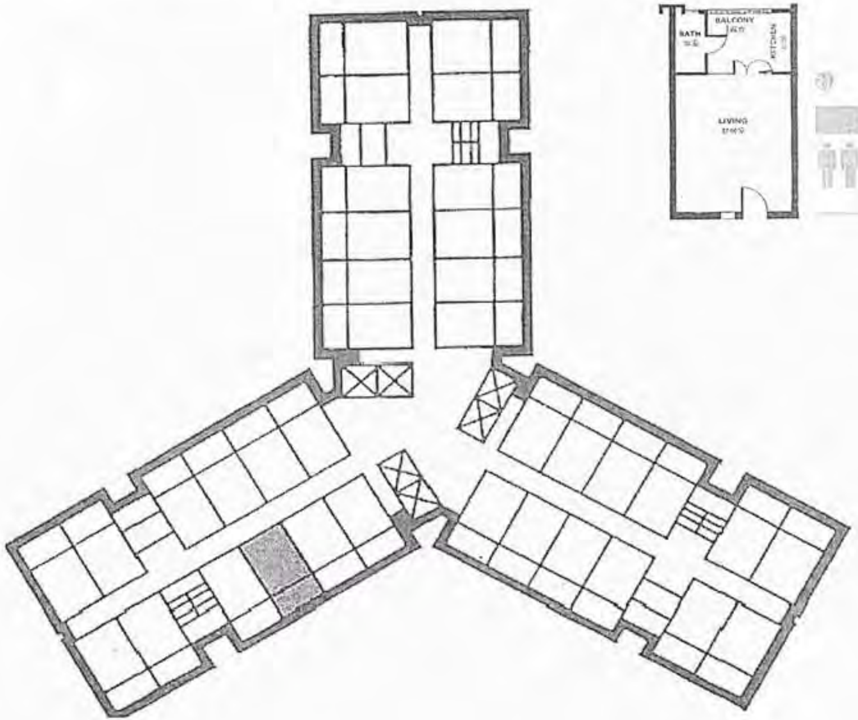
8m²

6.09

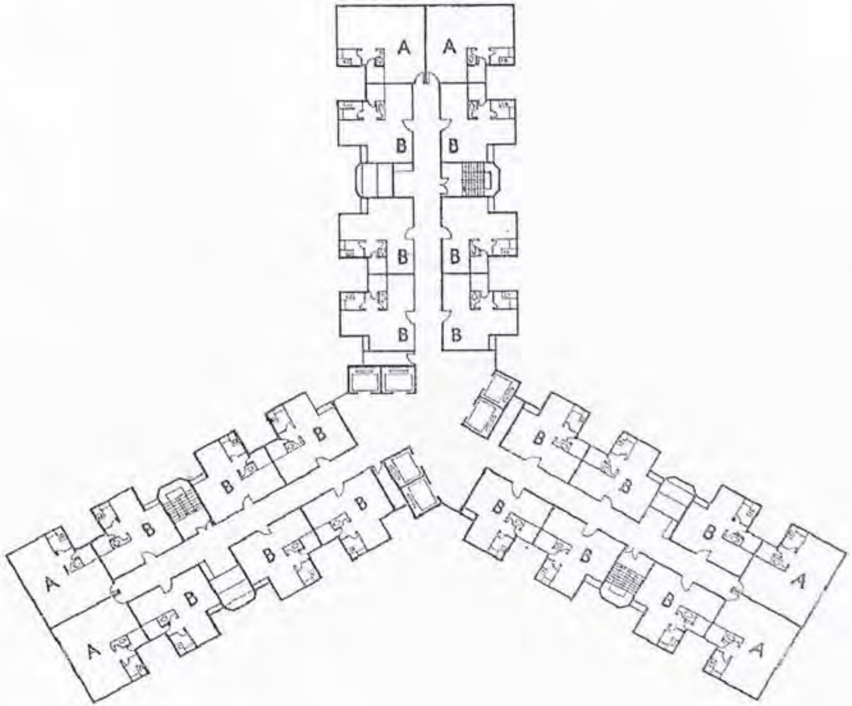
density

Trident 1 scale 1:500

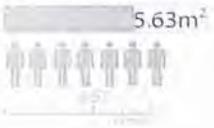
scale 1:200



Trident 2 scale 1:500

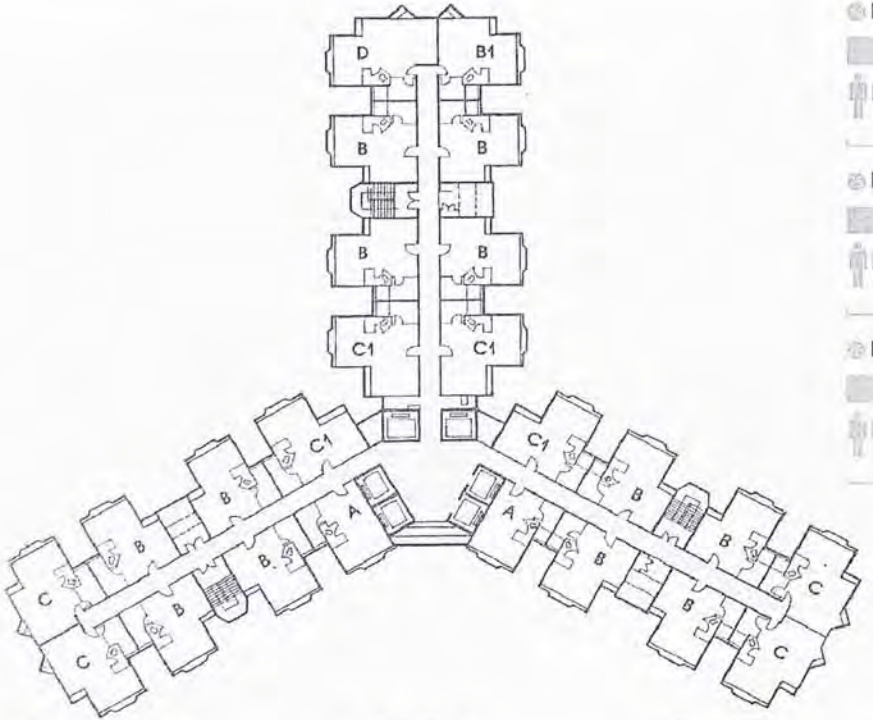


Flat A



Flat B

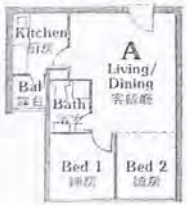
Trident 3 scale 1:500

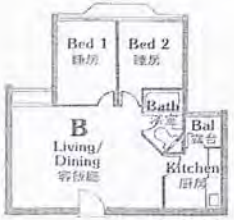


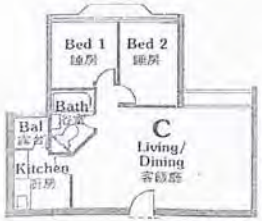
Flat A
35.44m²

Flat B
1.24m²

Flat C
5.23m²

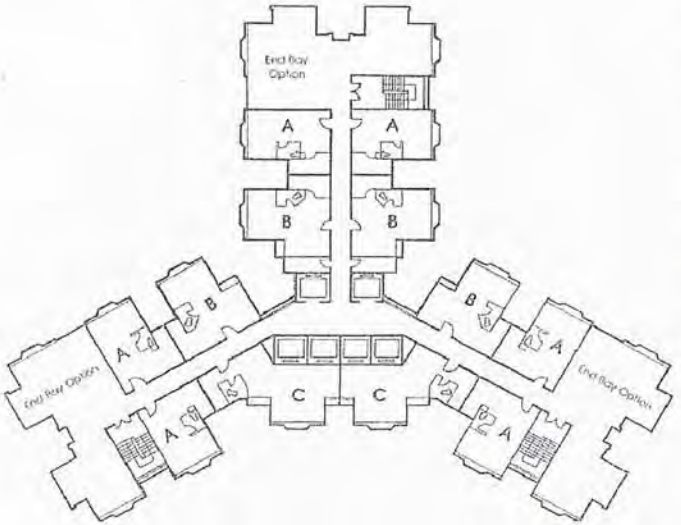






scale 1:200

Trident 4 scale 1:500

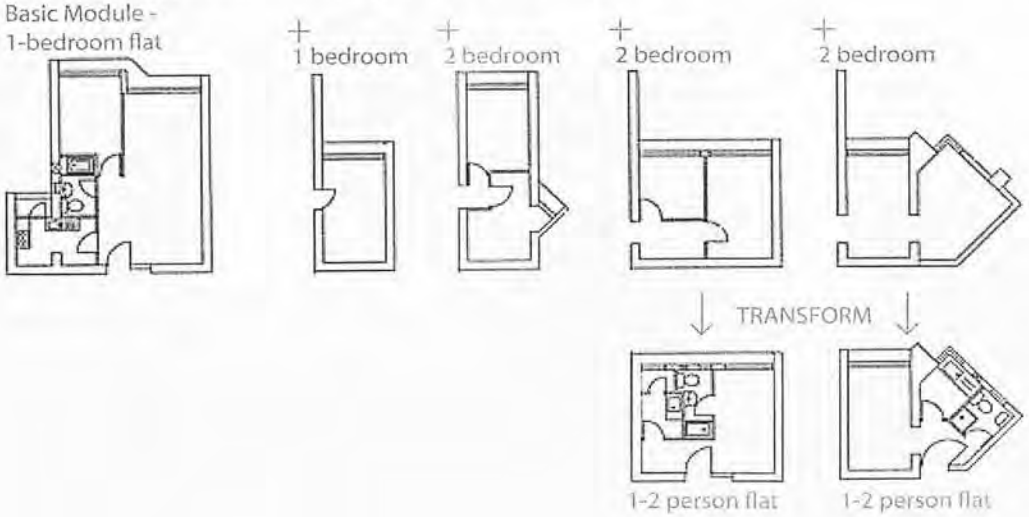


Flat A
34.39m²

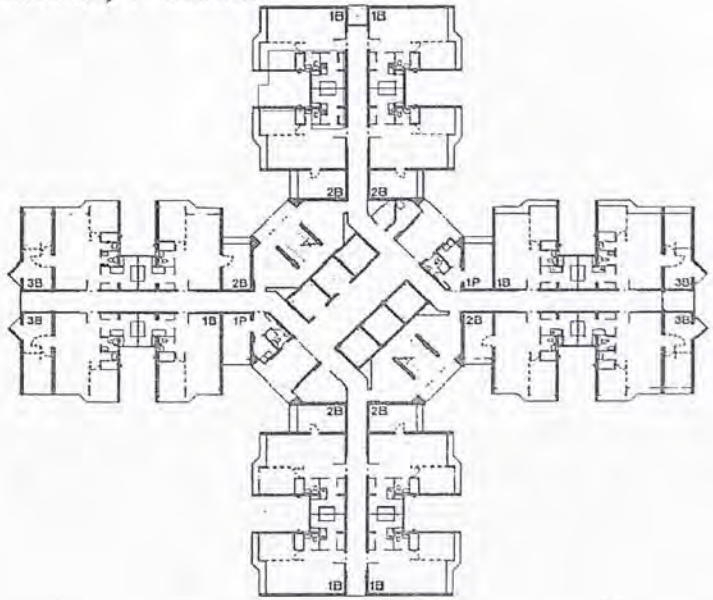
Flat B
0.69m²

scale 1:200

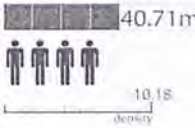
Design Concept of Harmony Type - Standardized unit



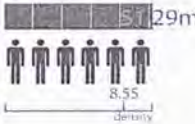
Harmony 1 scale 1:500



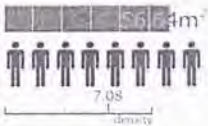
㉜ 1-Bedroom Flat



㉝ 2-Bedroom Flat

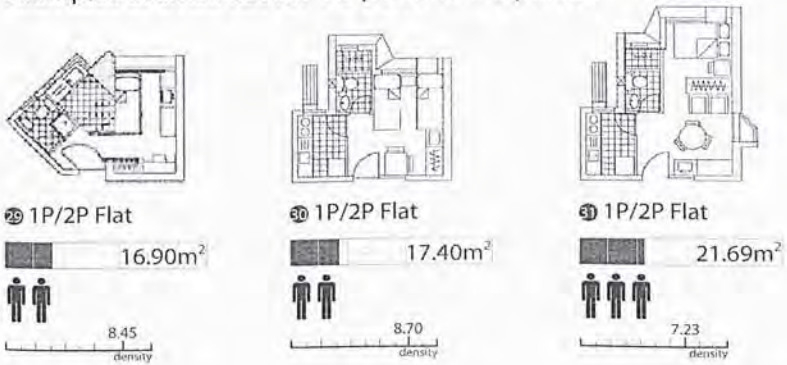


㉞ 3-Bedroom Flat



Examples of small flat for 1-2 person / 2-3 person

scale 1:200



㉙ 1P/2P Flat

16.90m²

8.45 density

㉚ 1P/2P Flat

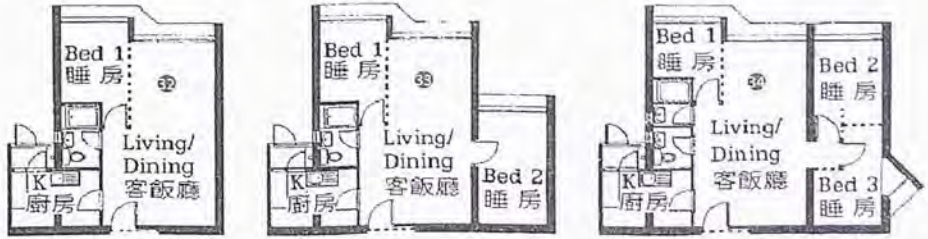
17.40m²

8.70 density

㉛ 1P/2P Flat

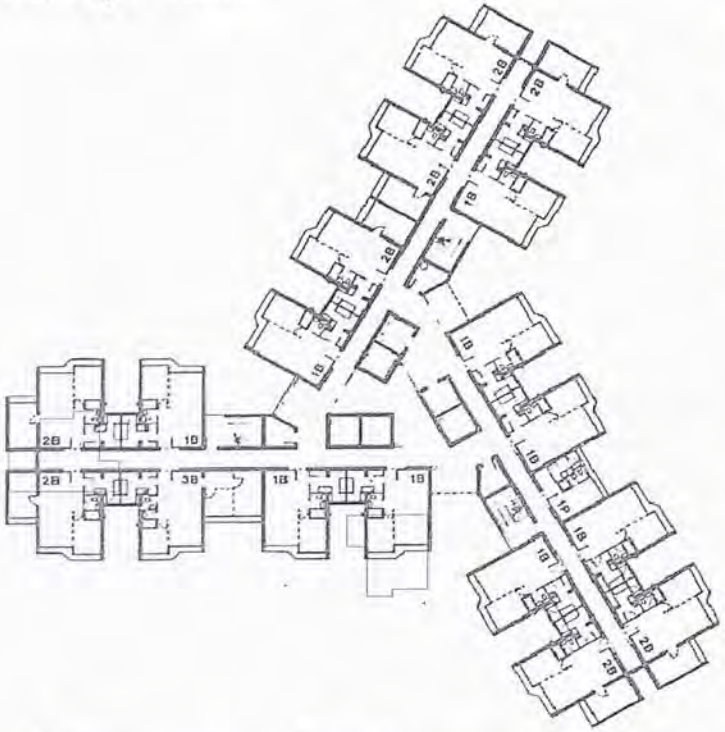
21.69m²

7.23 density



scale 1:200

Harmony 2 scale 1:500



㉟ 1-Bedroom Flat

40.69m²

10.17 density

㊱ 2-Bedroom Flat

51.05m²

8.51 density

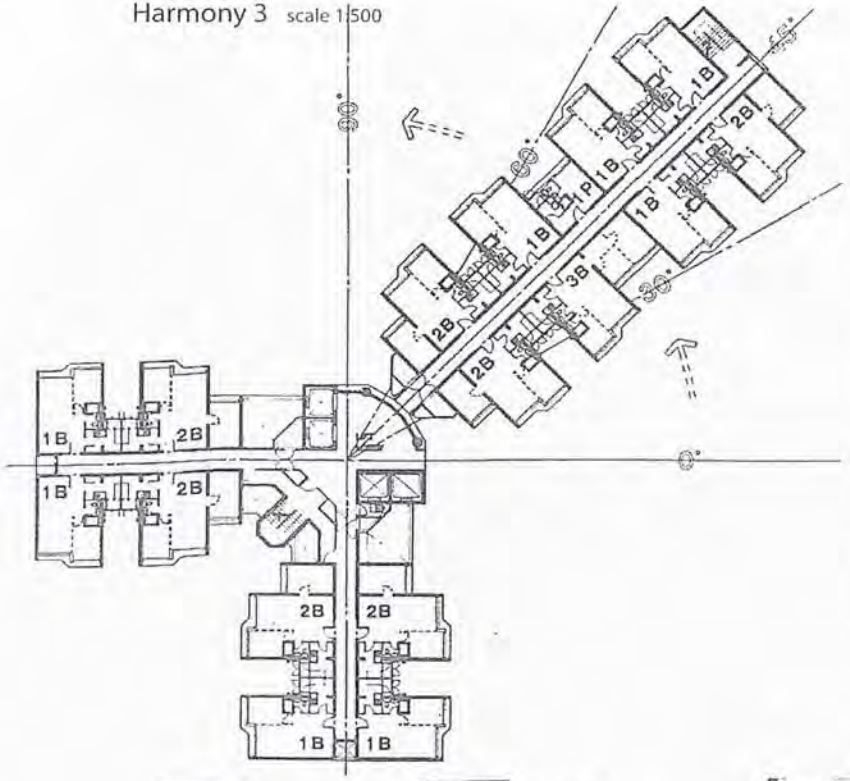
㊲ 3-Bedroom Flat

59.83m²

7.48 density

scale 1:200

Harmony 3 scale 1:500



㊳ 1-Bedroom Flat

39.84m²

9.96 density

㊴ 2-Bedroom Flat

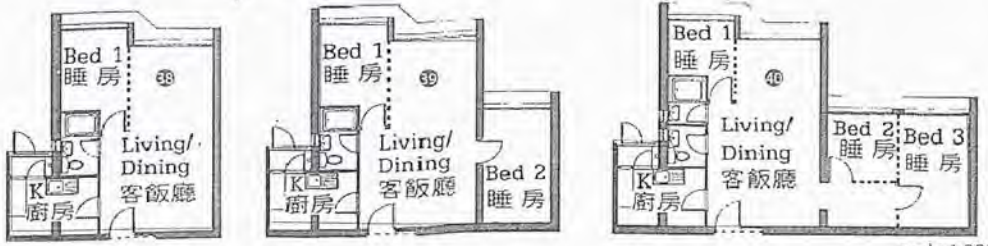
50.07m²

8.35 density

㊵ 3-Bedroom Flat

59.38m²

7.42 density



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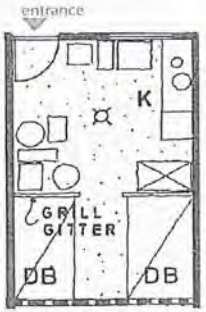
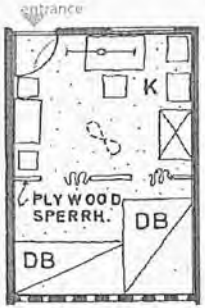


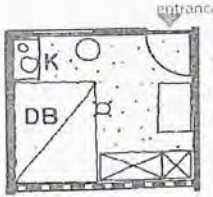


Mark I 1954

①Flat B

14.10m²

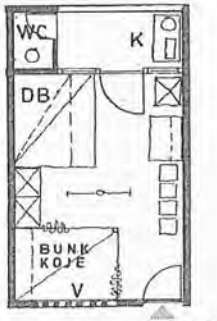
2.35 density

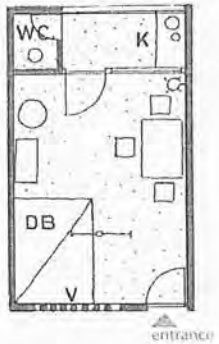


②Flat C

8.00m²

2.26 density



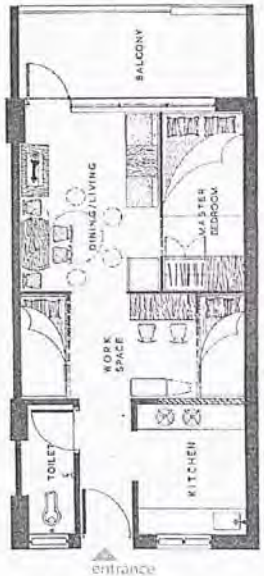


Mark IV 1965

③

14.80m²

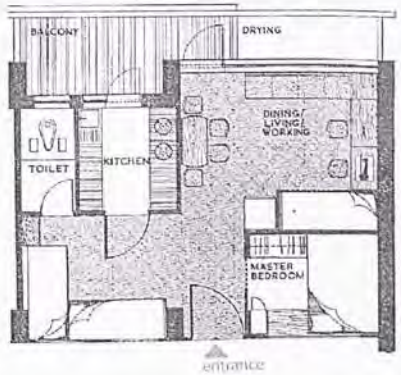
2.28 density



Old Slab - Sai Wan Estate 1958

34.78m²

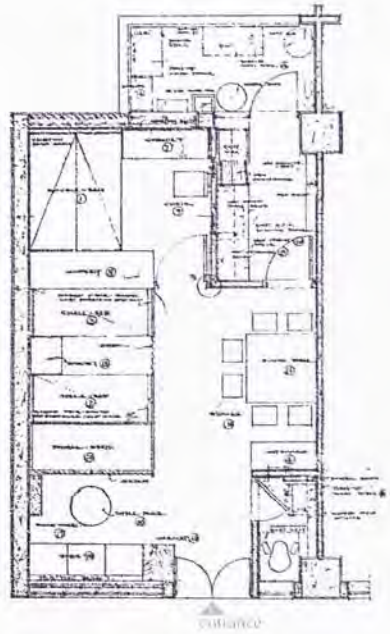
5.80 density



Non-standard - So Uk Estate Block E-I 1963

34.47m²

4.92 density



Non-standard - So Uk Estate Block P,Q,S 1963

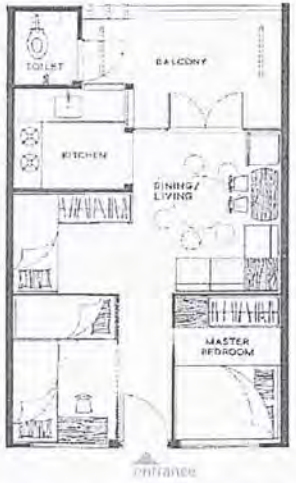
42m²

5.25 density

Old Slab - Choi Hung Estate
Block 1-8 1964

29.98m²

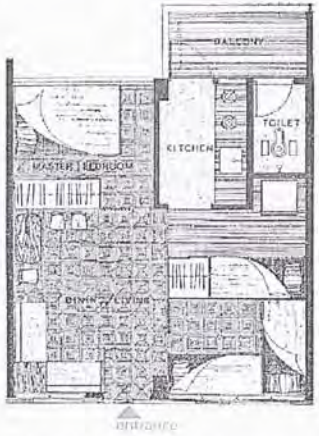
5.00
density



Old Slab - Ma Tau Wai Estate
Block A7-8 1965

35.66m²

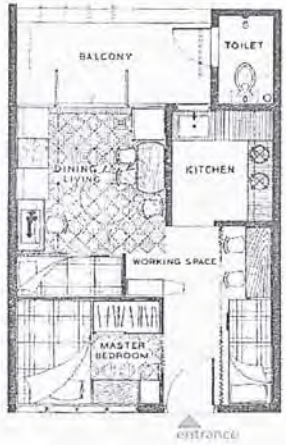
5.09
density



Old Slab - Wo Luk Estate
Block 1-8 1966

30.95m²

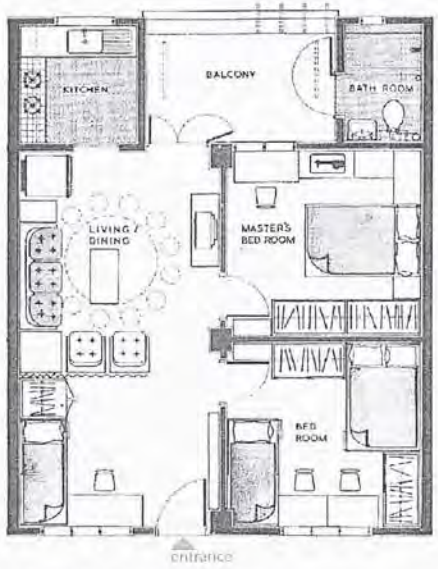
4.42
density



Old Slab - Wah Fu Estate
1967

30.34m²

5.06
density



Old Slab - Oi Man Estate
1974

62.71m²

4.25
density

SCALE 1:100

01

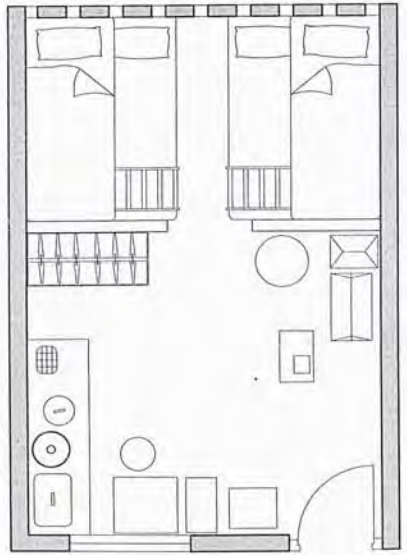
Mark I 1954

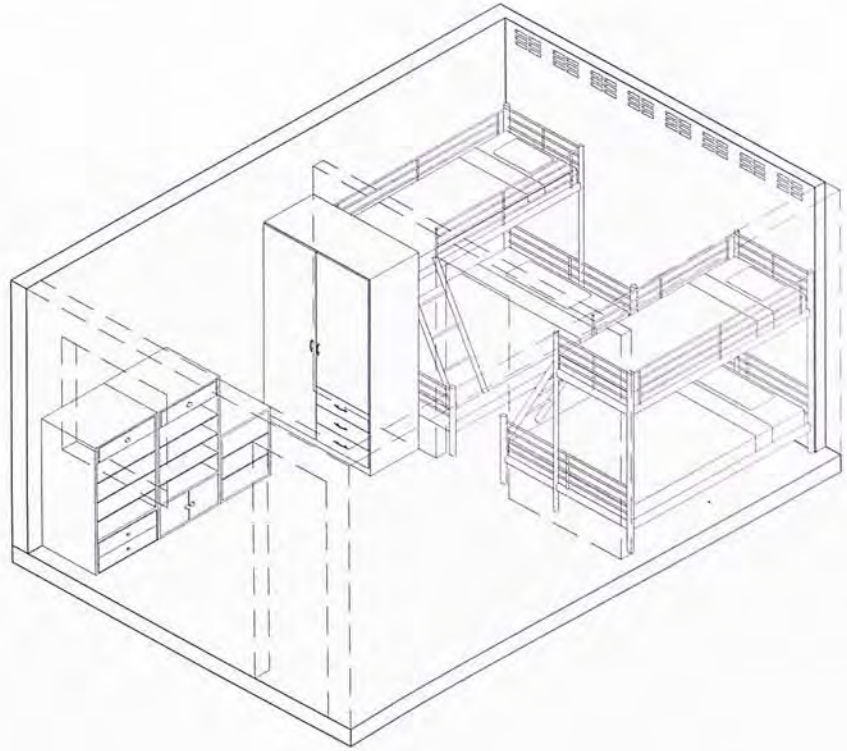
Flat B

14.10m²

2.35

density





Unit plan
1:60

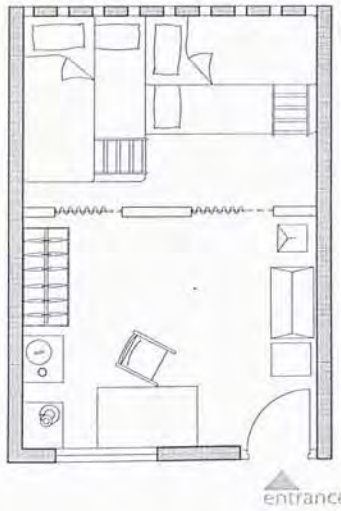
02

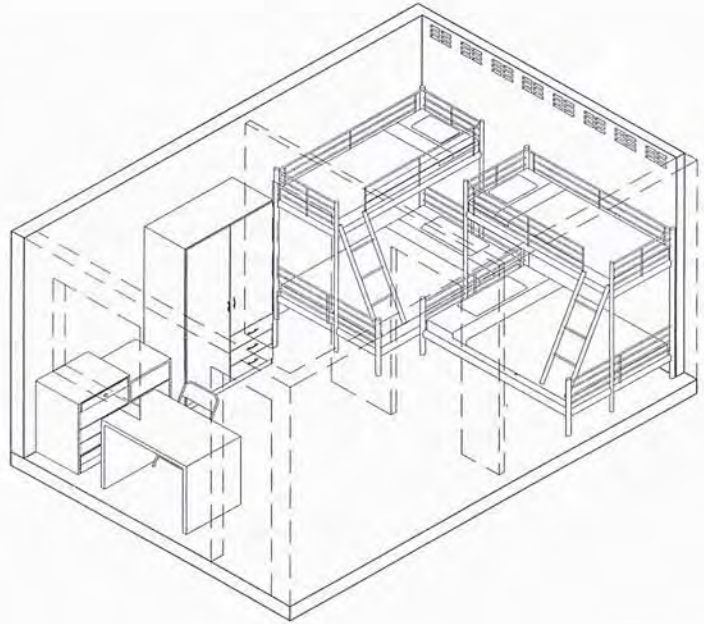
Mark I 1954

Flat B

14.10m²

2.35
density





Unit plan
1:60

03

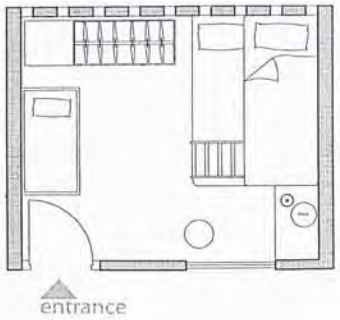
Mark I 1954

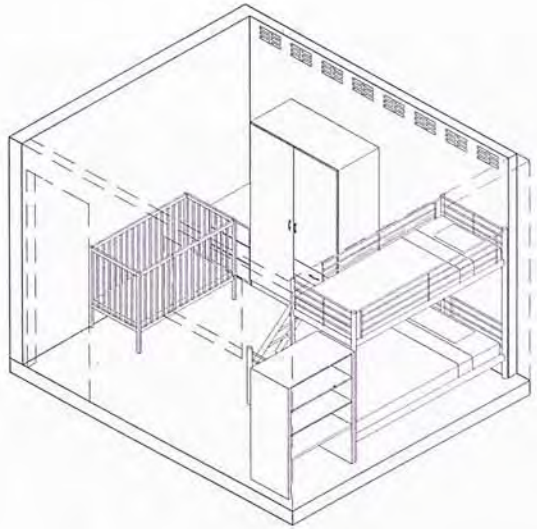
Flat C

8.00m²

2.29

density





Unit plan
1:60

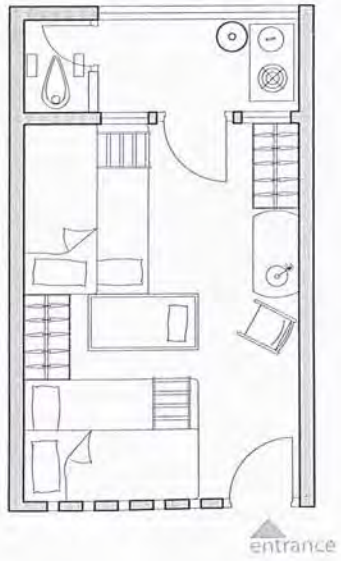
04

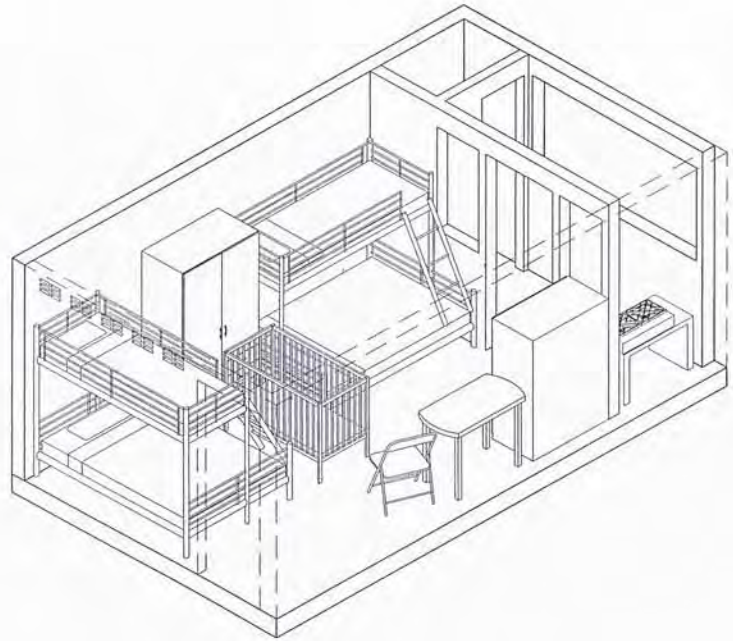
Mark IV 1965

14.80m²

2.28

density





Unit plan
1:60

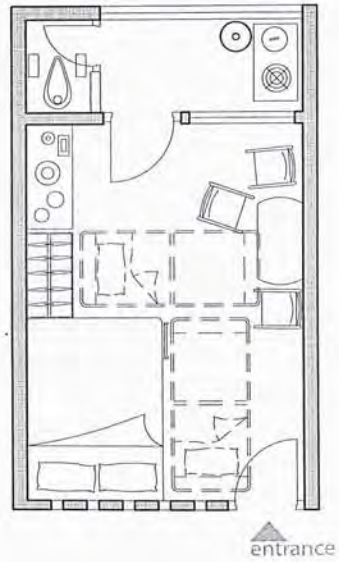
05

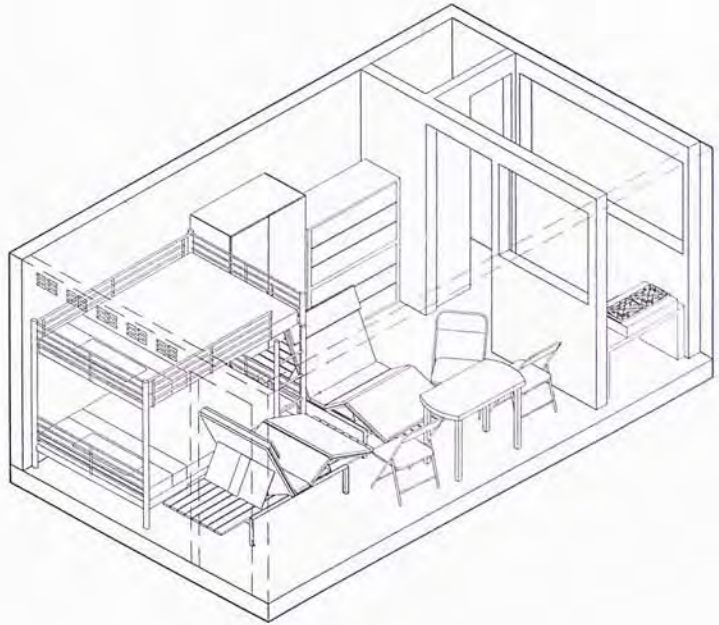
Mark IV 1965

14.80m²

2.28

density



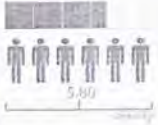


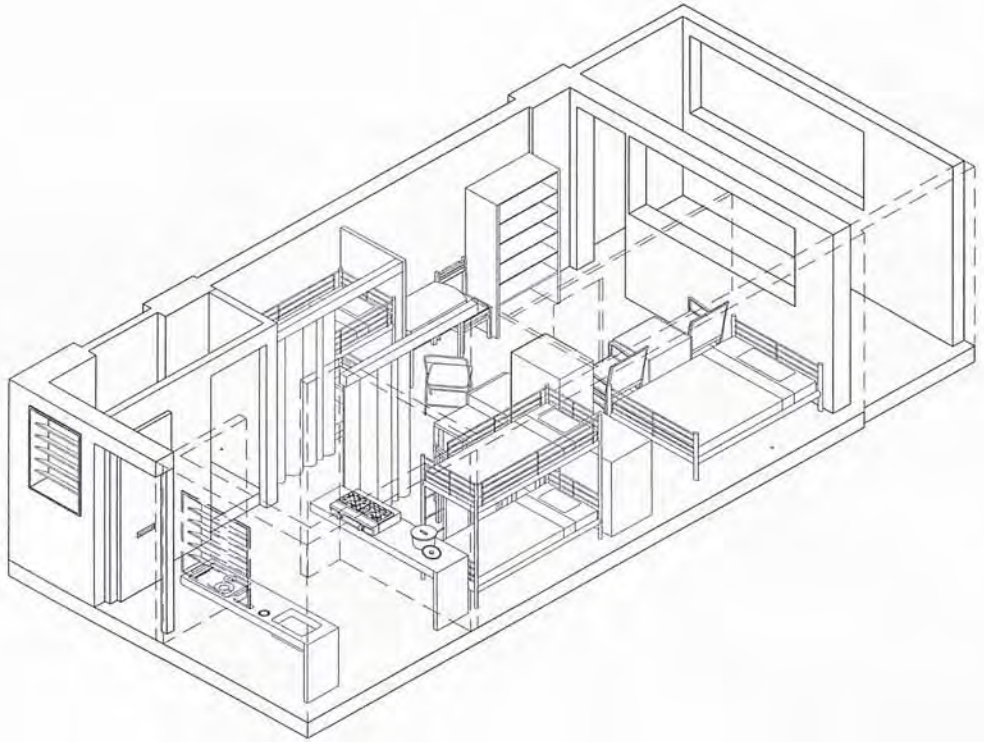
Unit plan
1:60

06

Old Slab - Sai Wan Estate
1958

34.78m²





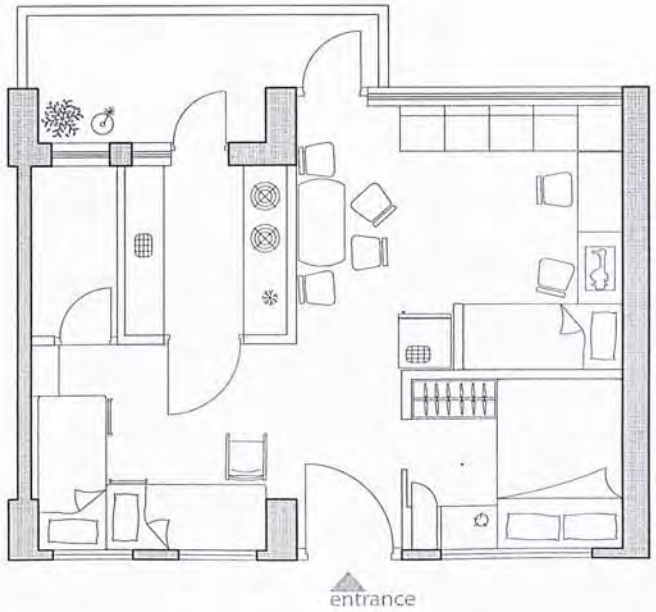
Unit plan
1:60

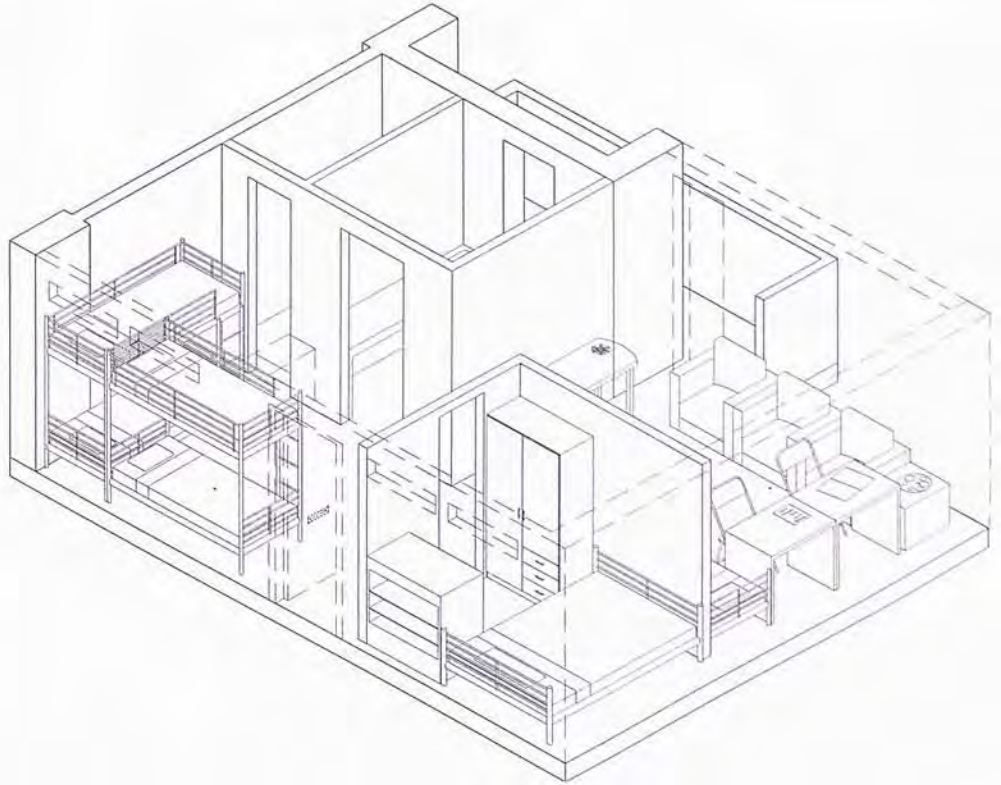
07

Non-standard - So Uk Estate
Block E-I 1963

34.47m²

4.92
density





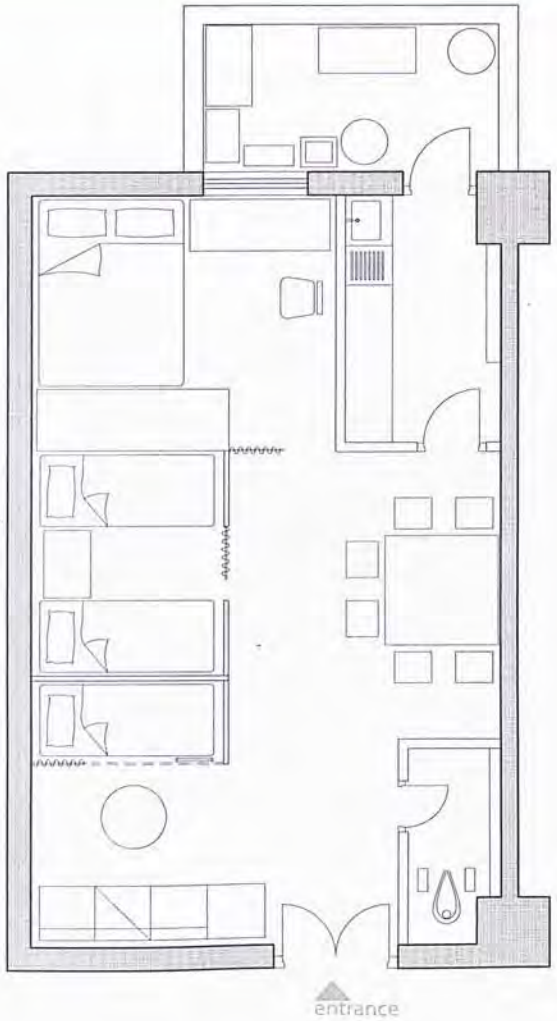
Unit plan
1:60

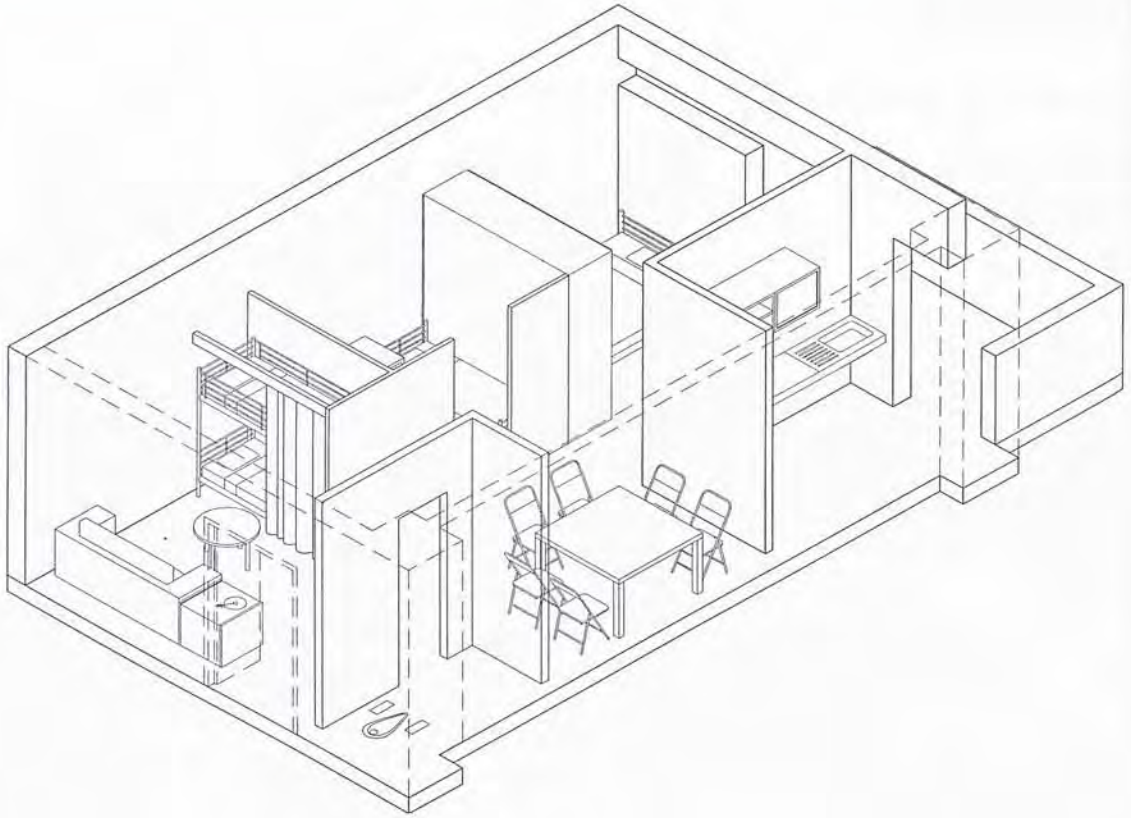
08

Non-standard - So Uk Estate
Block P,Q,S 1963

42m²

5.25





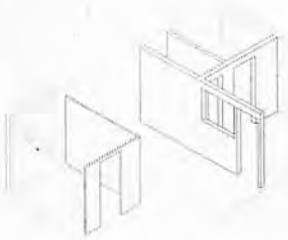
Unit plan
1:60

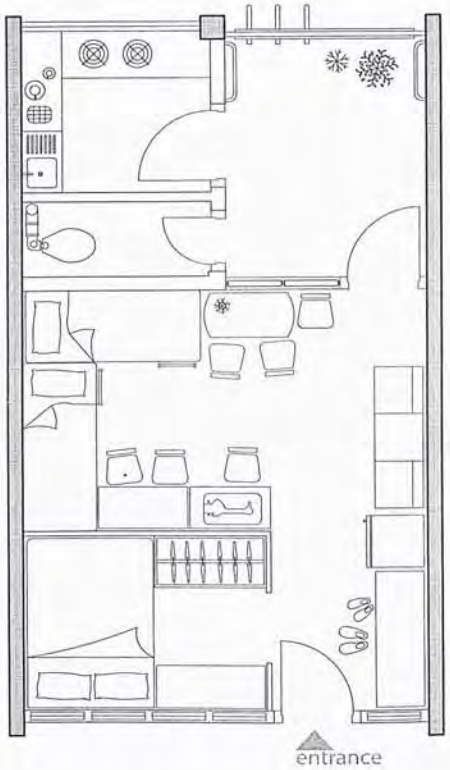
09

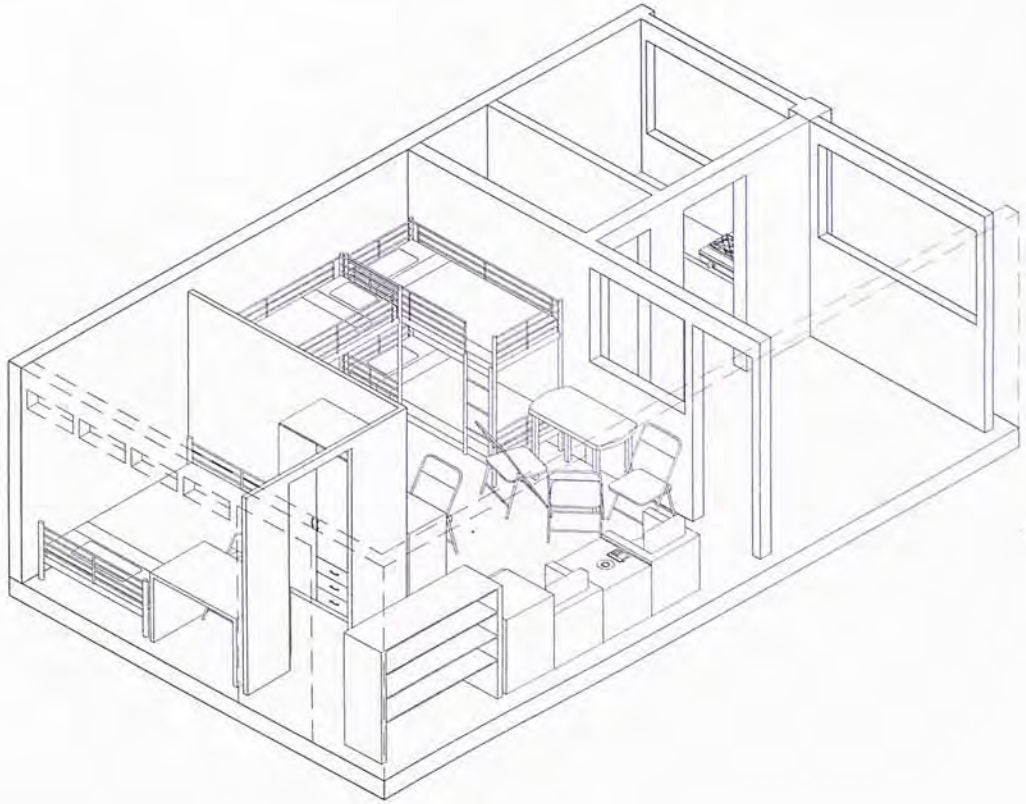
Old Slab - Choi Hung Estate
Block 1-8 1964

29.98m²

5.00
density







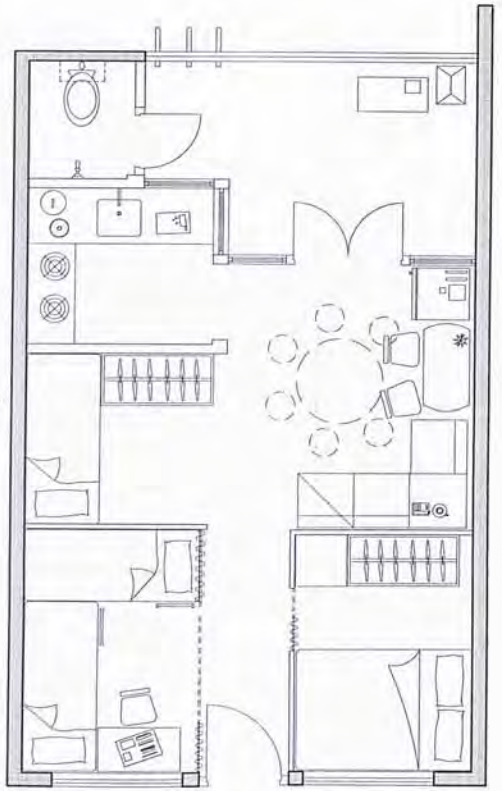
Unit plan
1:60

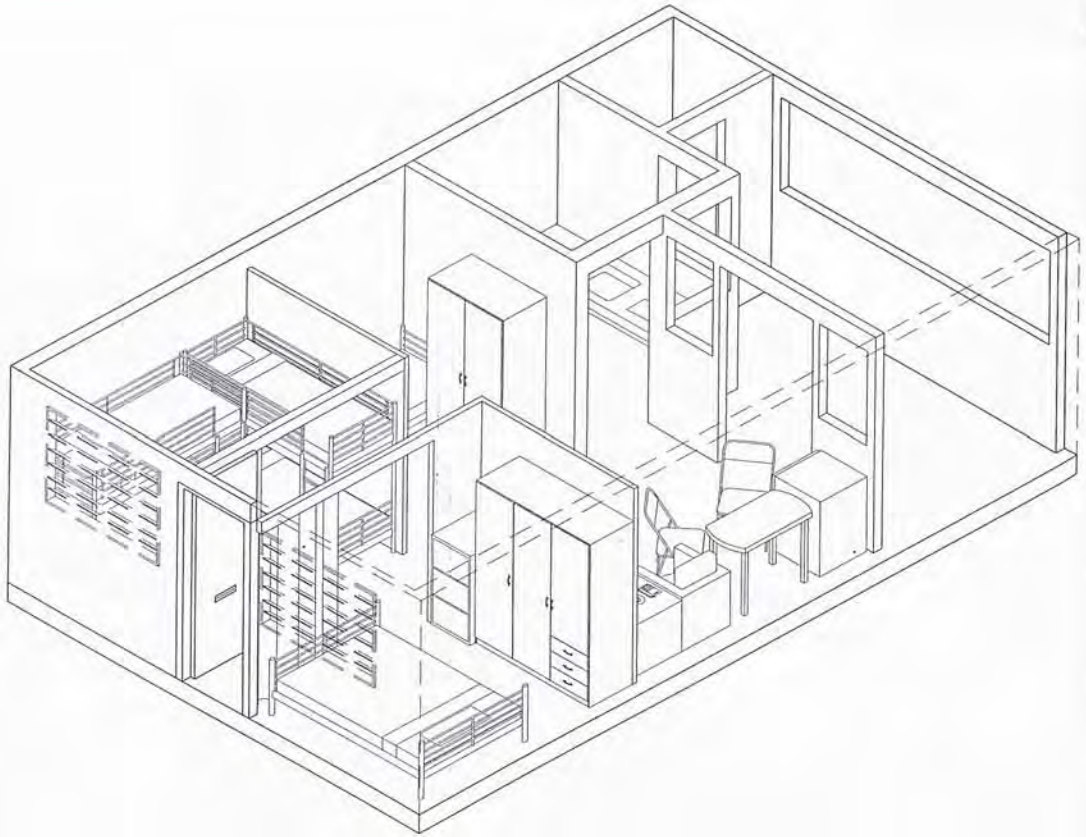
10

Old Slab - Ma Tau Wai Estate
Block A7-8 1965

35.66m²

5.09





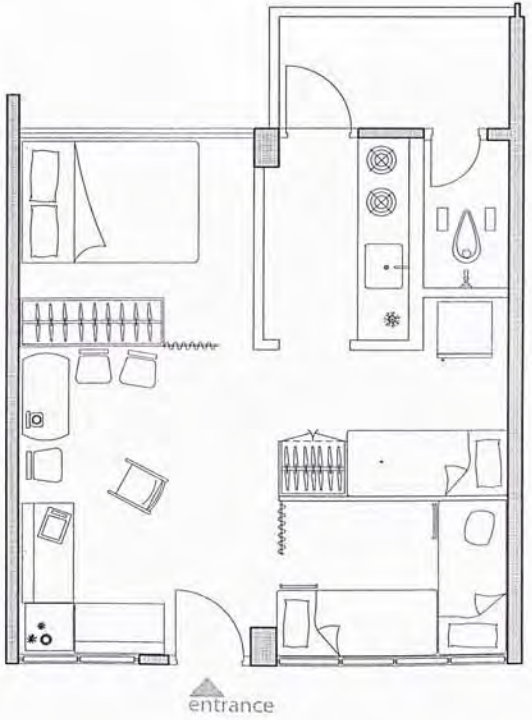
Unit plan
1:60

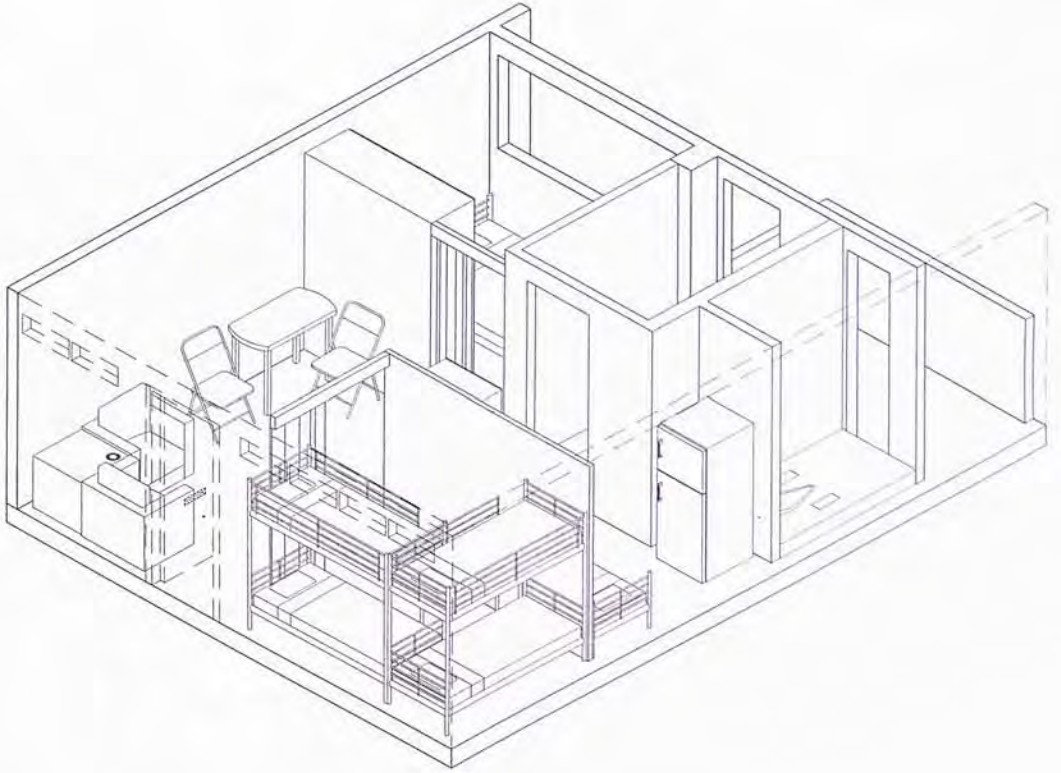
11

Old Slab - Wo Luk Estate
Block 1-8 1966

30.95m²

4.42
density





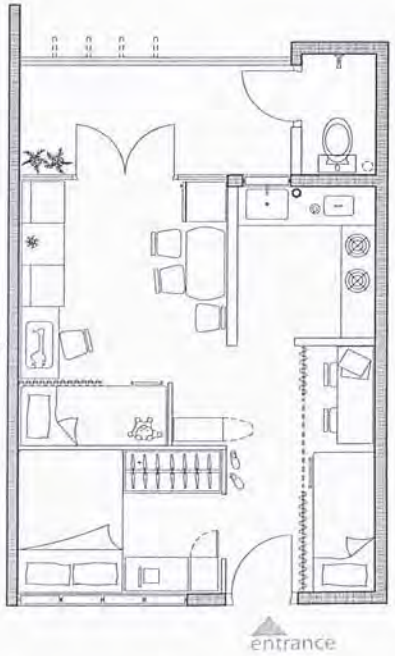
Unit plan
1:60

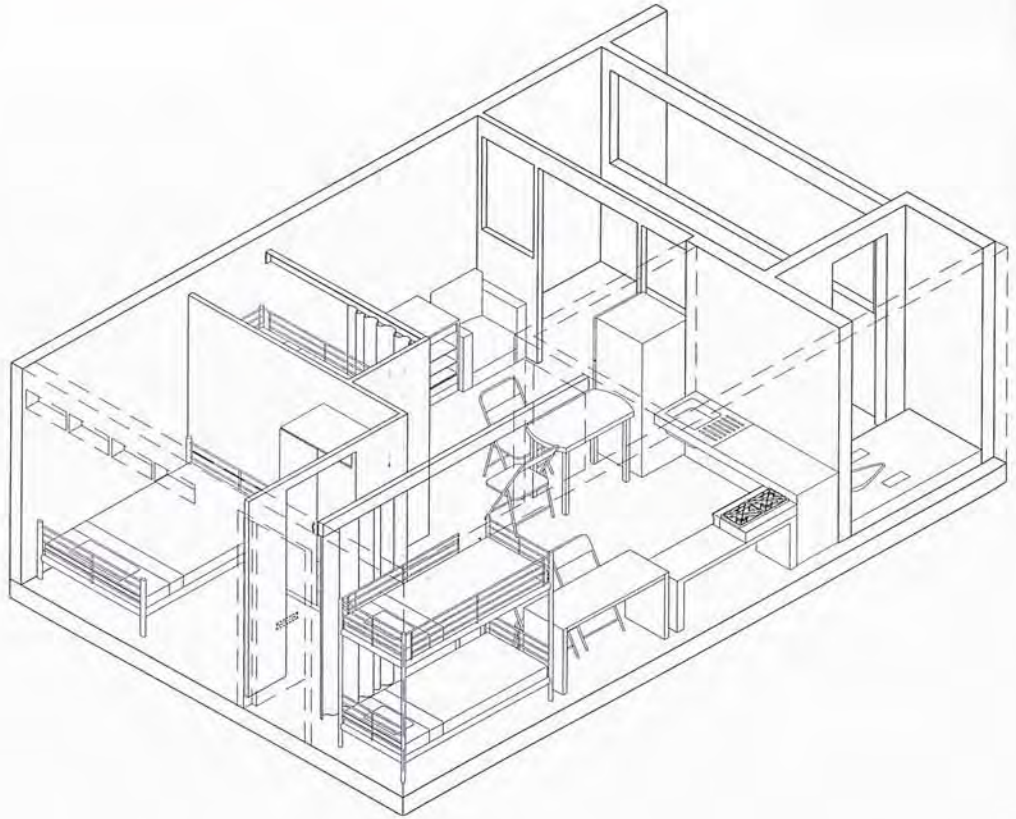
12

Old Slab - Wah Fu Estate
1967

30.34m²

5.06

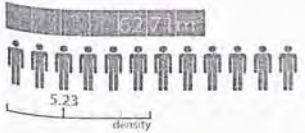


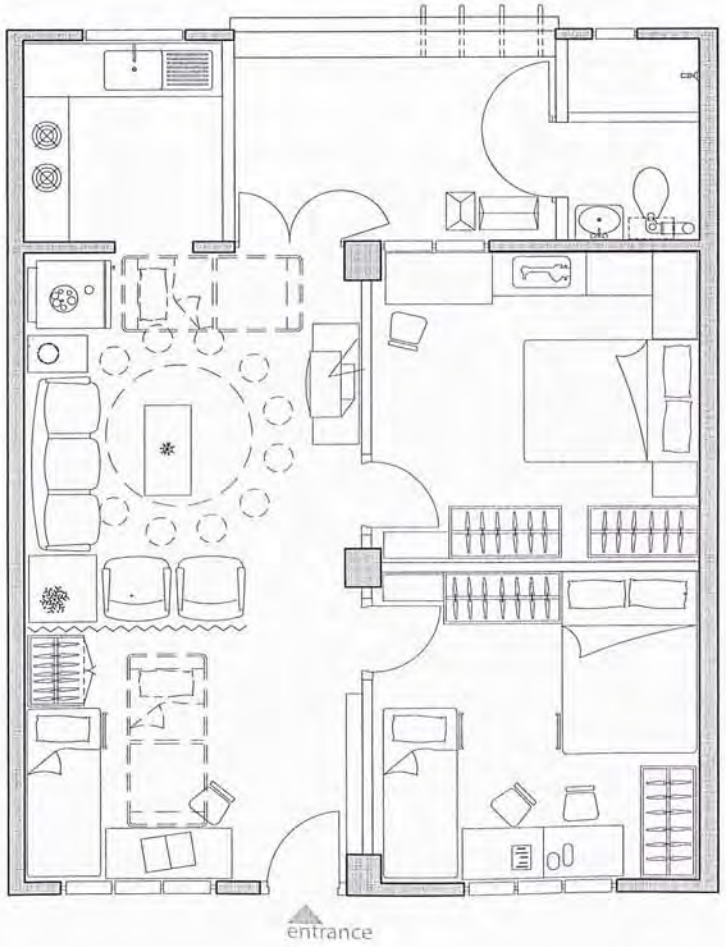


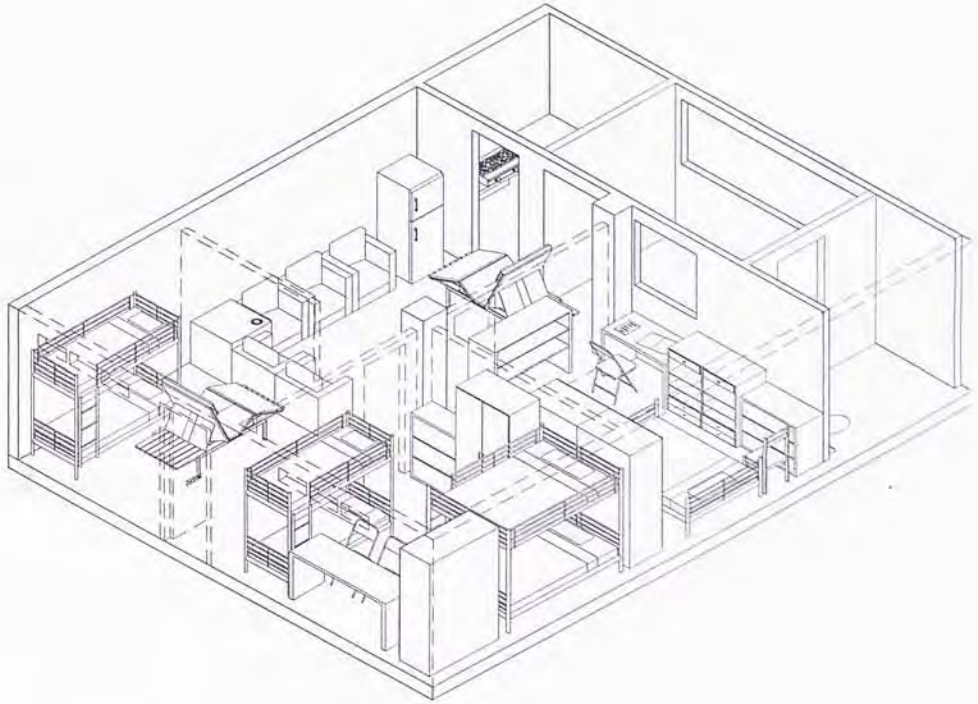
Unit plan
1:60

13

Old Slab - Oi Man Estate
1974







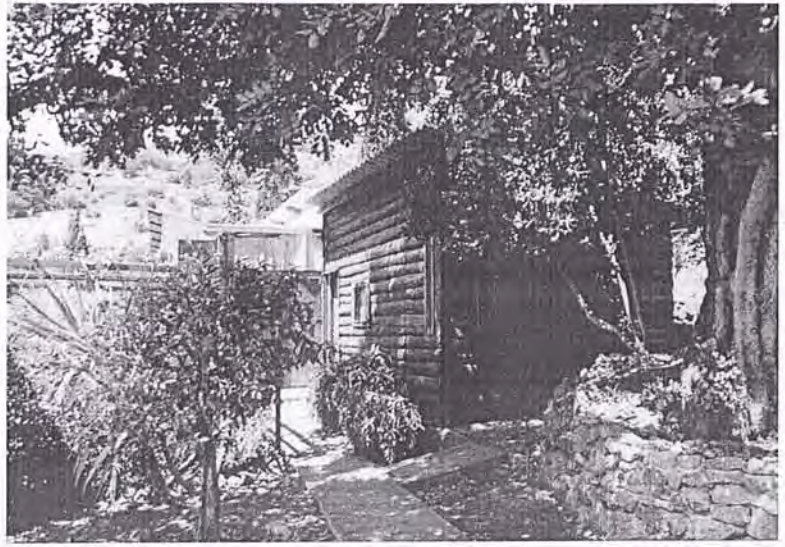
Unit plan
1:60

01

House / Collective Housing

Le Petit Cabanon

by Le Corbusier 1951-52
Roquebrune-Cap-Martin,
France

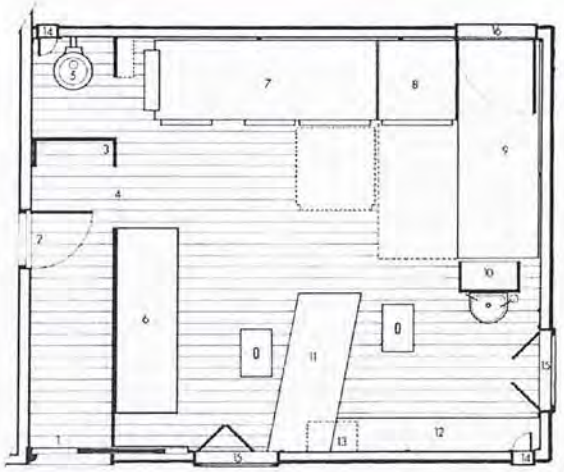


In 1951, Le Corbusier built a summerhouse in the south of France for his wife, calling it a cabanon (Le Petit Cabanon, Roquebrune-Cap-Martin). It faces the Mediterranean Sea next to the Etoile de Mer bar-restaurant that the couple visited each summer.

The building is a square, measuring 3.66 meters in each direction with ceiling height 2.26m based upon the 1.83m height of the "ideal man" with an upraised arm. It is also equal in size to an eight-tatami-mat room. This space was based on his modular scale, which implements the golden section and measurements derived from the human body.

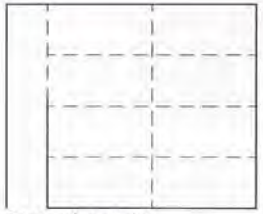
Inside, there were two beds, a small table and the minimum necessary storage, toilet and small basin. There were no kitchen because he could eat at the restaurant next door.

It is an extremely small space and an investigation of minimal dwelling space.

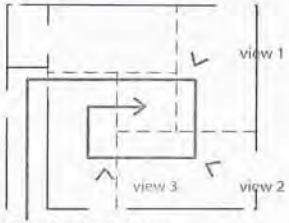


Unit plan
1:50
14 sqm / 2 people

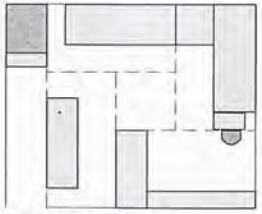
1 Entrance
2 Door to the restaurant
3 Wardrobe
4 Access to living space
5 WC
6 Cabinet
7 Bed
8 Coffee table
9 Bed
10 Basin
11 Table
12 Bookshelf
13 High level bookshelf
14 Vertical ventilation opening
15 700x700 window
16 330x700 window



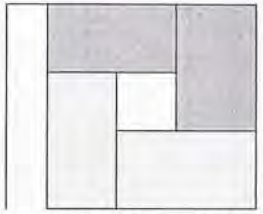
8 tatami-mat size



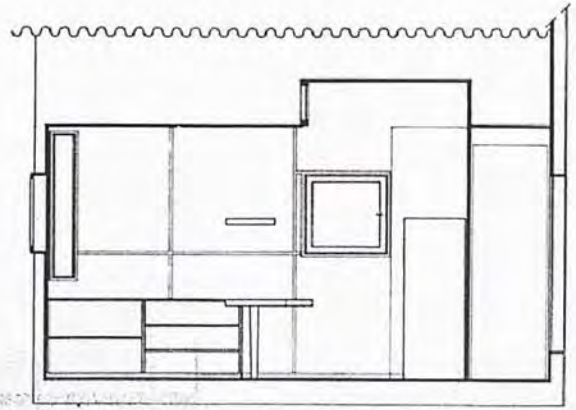
Circulation & views



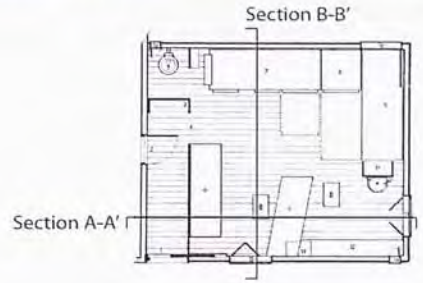
Furniture layout

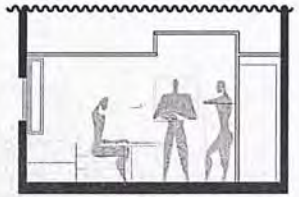


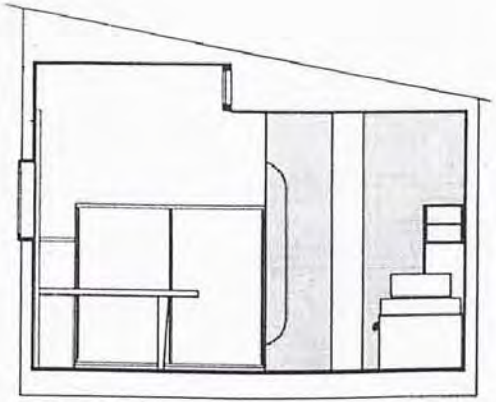
Daytime & Nighttime zoning



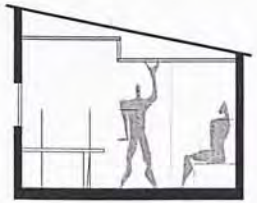
Section A-A'

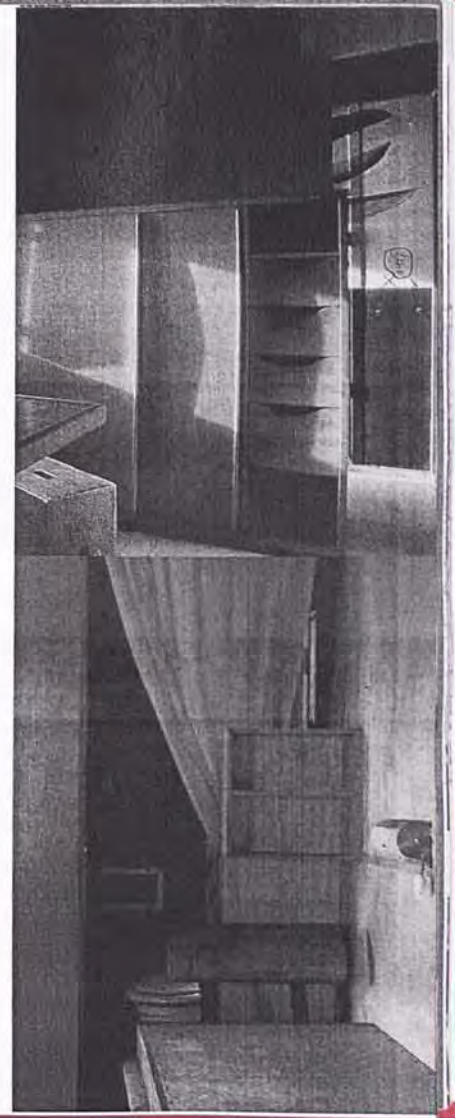






Section B-B'
Scale 1:50



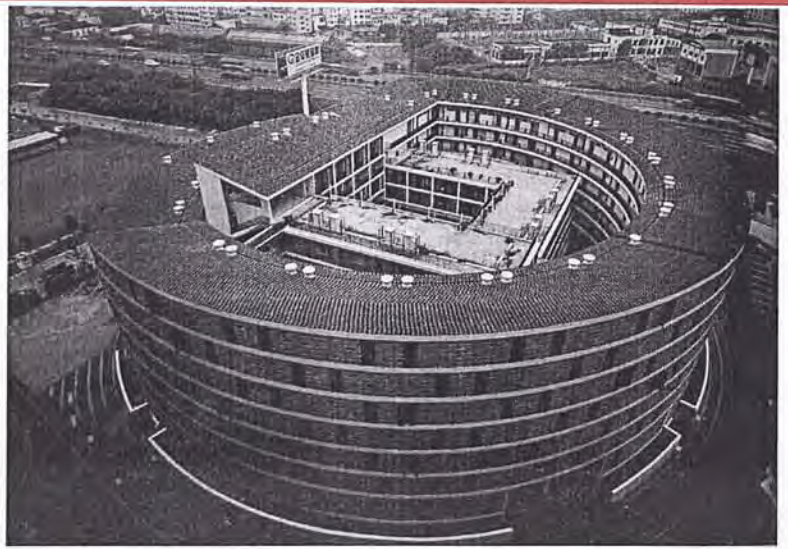


02

House / Collective Housing

Urban Tulou

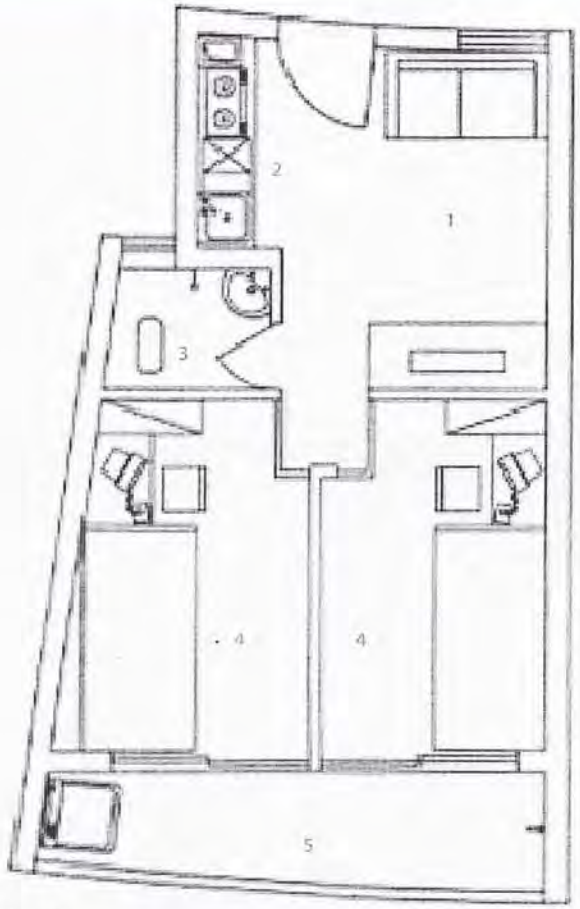
by Urbanus
Guangdong, China
2008



Urban Tulou is an affordable housing for China. The design is inspired by the traditional vernacular form of Tulou. Tulou is a unique dwelling type to the Hakka people.

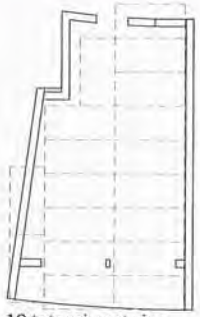
Units in traditional Tulou are laid out along its perimeter. Tulou helps to insulate the users from outside nosie and create internal space.

The units typically are 30sqm for two couples with maximum five people to live together. This unit includes living room, two bedrooms, kitchen, washroom and balcony. Some programmes happen in overlapped space so as to minimize the area needed but ensure all functions are included. For example, an open kitchen is placed next to the corridor so that no partition wall is needed and eliminates the area for building partition wall.

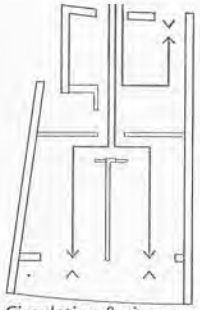


Unit A
1:50
30 sqm / 4 people

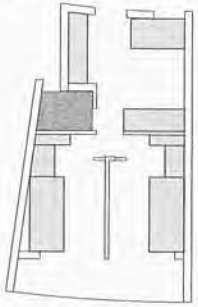
1 Living/Dining Room
2 Open Kitchen
3 Shared Washroom
4 2 single bedroom
5 Shared balcony



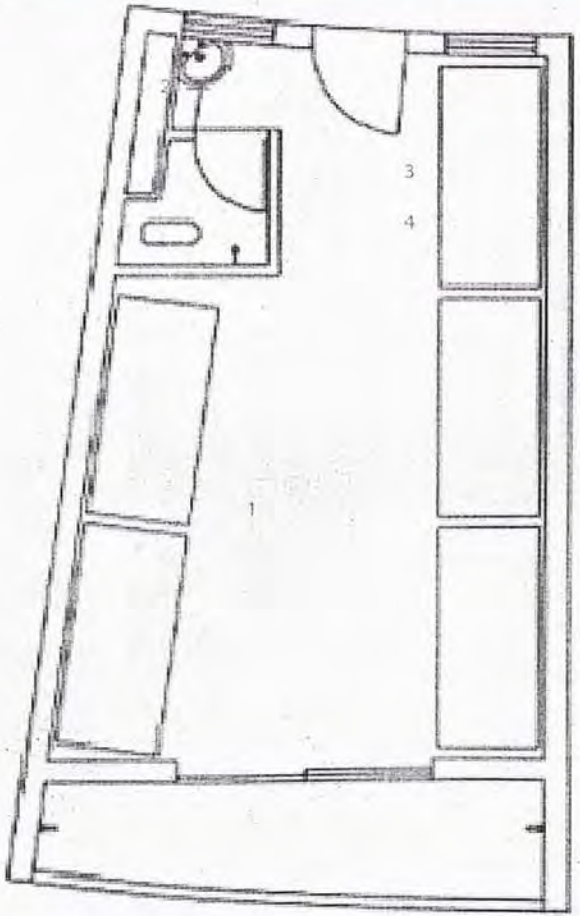
19 tatami-mat size



Circulation & views

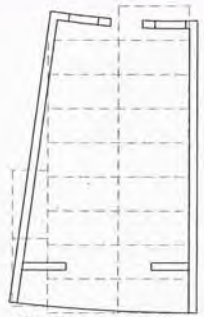


Furniture layout

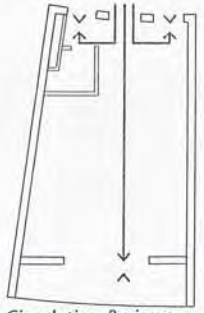


Unit B
1:50
30 sqm / 5 people

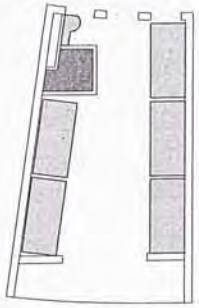
1 Living/Dining Room/ Kitchen
2 Shared Washroom
3 5 single beds
4 Desks & wardrobe
underneath the bed



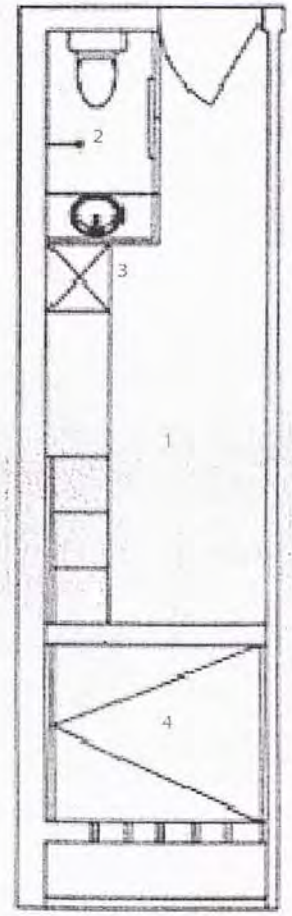
19 tatami-mat size



Circulation & views



Furniture layout

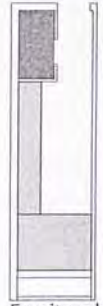


Unit B
1:50
15 sqm / 2 people

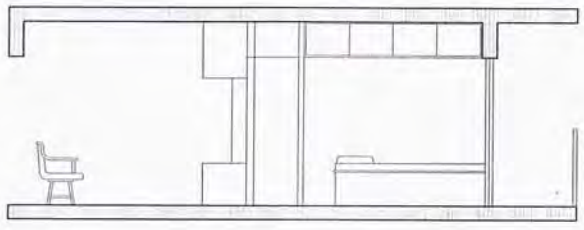
1 Living/Dining Room
2 Washroom
3 Open Kitchen
4 1 Double bedroom

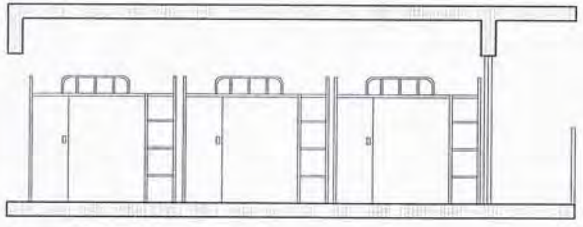
9 tatami-mat size

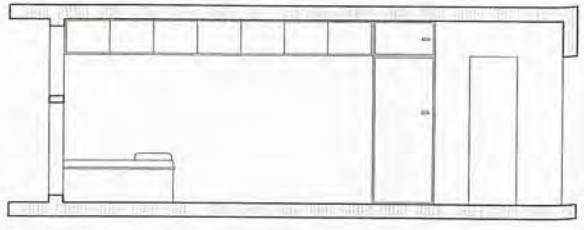
Circulation & views

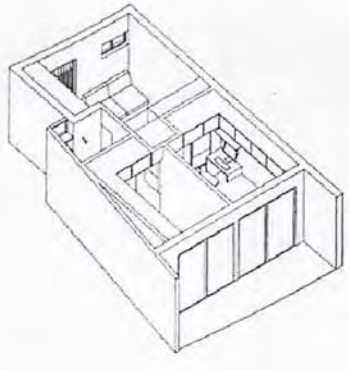


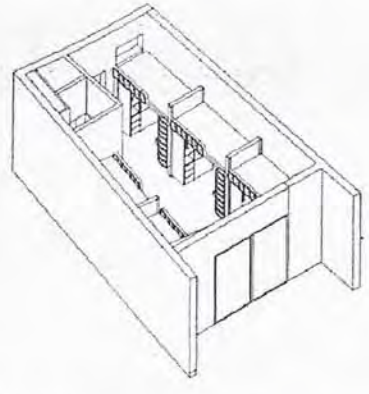
Furniture layout

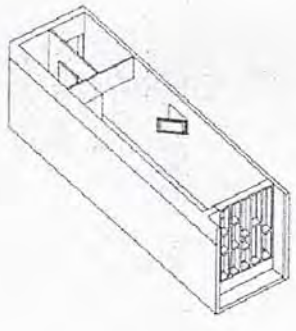




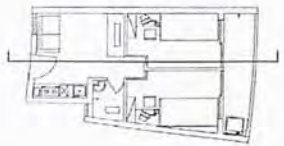




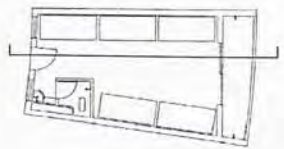




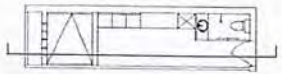
Section A-A'



Section B-B'



Section C-C'
Scale 1:1oo

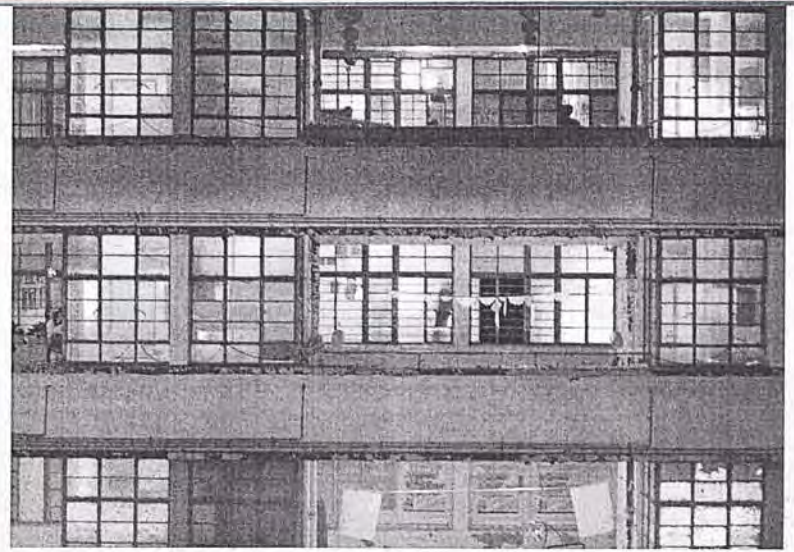


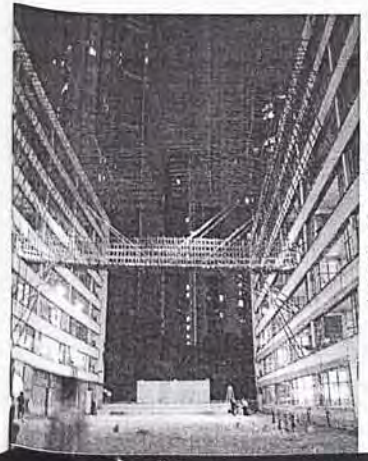
03

House / Collective Housing

Old Hong Kong Police Housing Quarters

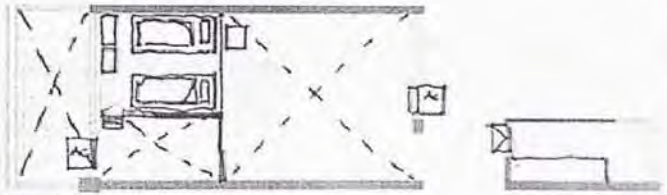
Holloywood Quarters, Hollywood Road, Hong Kong
1951





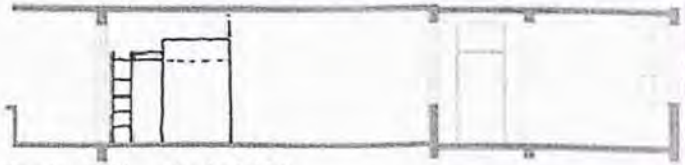
In 1950, the Hong Kong Government launched a housing programme for all serving and married officers of the rank and file of the Hong Kong police. It is no doubt that this programme was of great importance in the history of Hong Kong police force. It also marked one of the highest achievements in Hong Kong modern architecture.
There are two unique housing types developed through this programme. Built in 1951, the first Hollywood Road Quarters is a "multi-storey type". It features a public corridor separating the kitchen and an open space from the main unit. We believe that this type had a great influence on the later large-scale public housing development in Hong Kong.

Typical Unit floor plan - Level 1



Level 2

Section A-A'

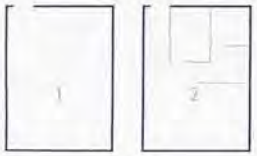


Section B-B' Scale 1:130

04

House / Collective Housing

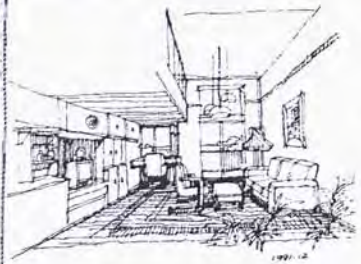
High-efficient space
residential design
by Bao Jiasheng
China
1992



Support House Concept
1 structural element - Unit enclosure
2 space defining element - Partition wall, Furniture

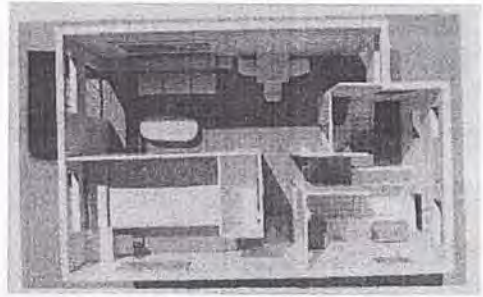
High-efficient Residential Design Concept

i. Net floor height increase from 2.7~2.8m to 3.4m
ii. No fixed partition wall, only thin wall / furniture as space defing element
iii. Promote loft space as bedroom
- above kitchen, washroom area
- above furniture e.g. bed, shelf, sofa etc
iv. Level 1 floor height = 2m
Level 2 floor height = 1.4m

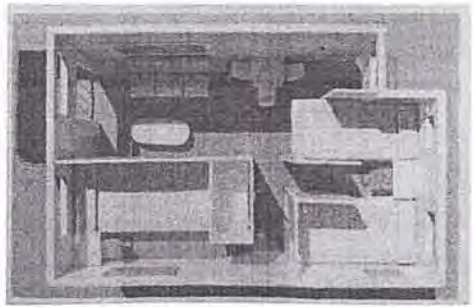


04.1 Single Span 3.3-4.8m Experimetal Unit

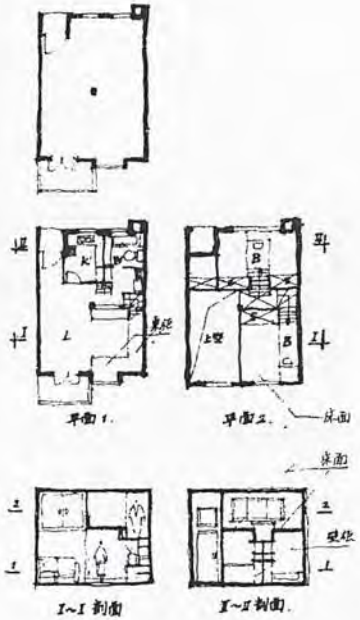
Area : 34.56 sqm, usable floor area increase by 75%
People : 4-6
Living Room : 18 sqm, double floor height
Site : Shanghai, Tianjin



Level 1 - Living Room, Small Dining Room, Kitchen and washroom

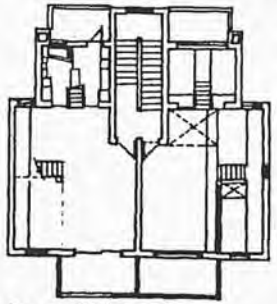


Level 2 - Bedroom, wardrobe



1-room unit plan sketches

04.2 Double Span 5.1-6.6m Experimetal Unit



Second Floor Plan

Area : 50 sqm with staircase,
usable floor area increase by 50%

Site : Huainan

04.3 Split-level unit design

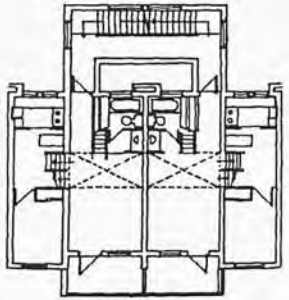
Major: Minor net floor height : 2:3

Major net floor height : min. 3.3m, split into 2 levels

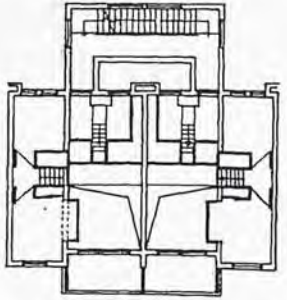
Minor net floor height : min. 2.2m, split into 3 levels

Site : Nanjing, [illegible]

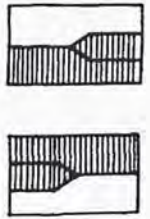
04.3.1 Nanjing



Second Floor Plan

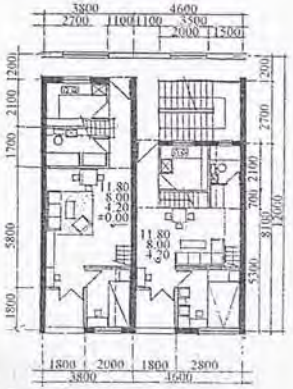


Mezzanine Floor Plan

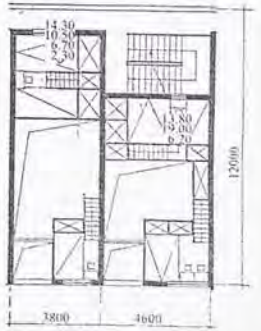


Section diagrams along
North-West direction

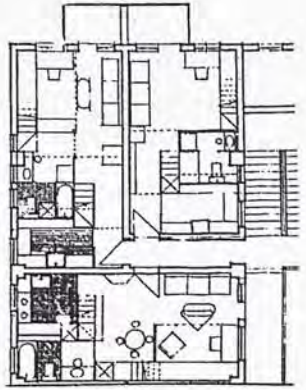
04.3.2 [illegible]



Level 1 Floor Plan



Level 2 Floor Plan

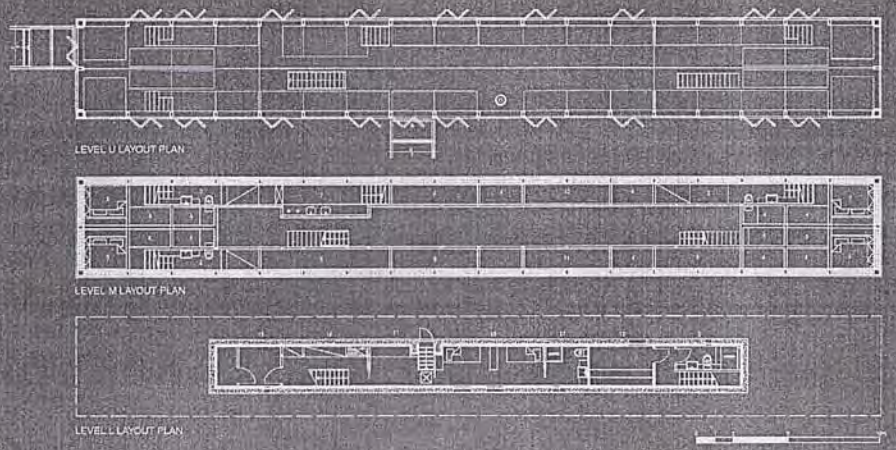


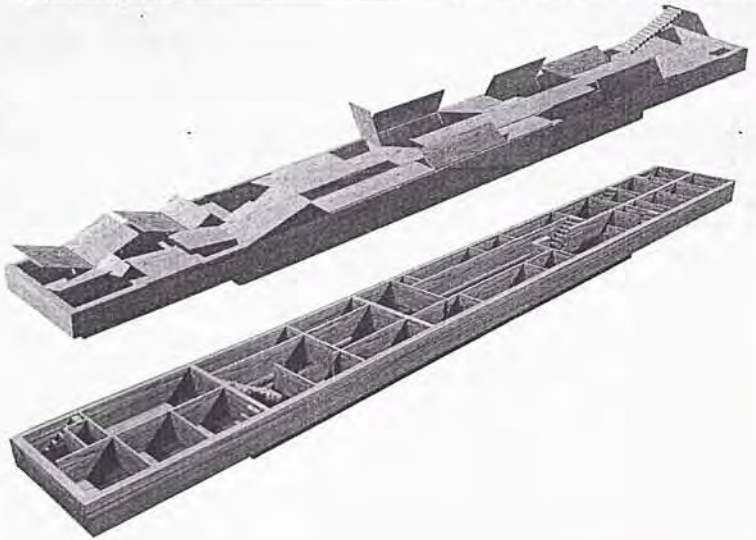
Variations on Floor Plan

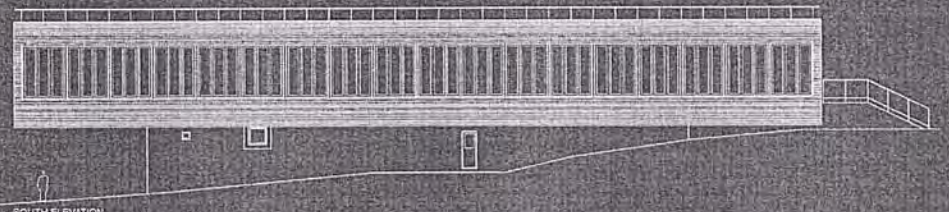
05

Suitcase concept -
House / Collective Housing
Suitcase House

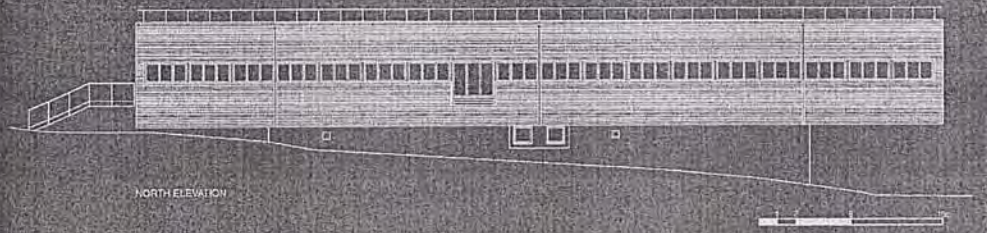
by Gary Chang 2006
The Commune By the
Great Wall
Shuiguan, Badaling,
The Great Wall, Beijing



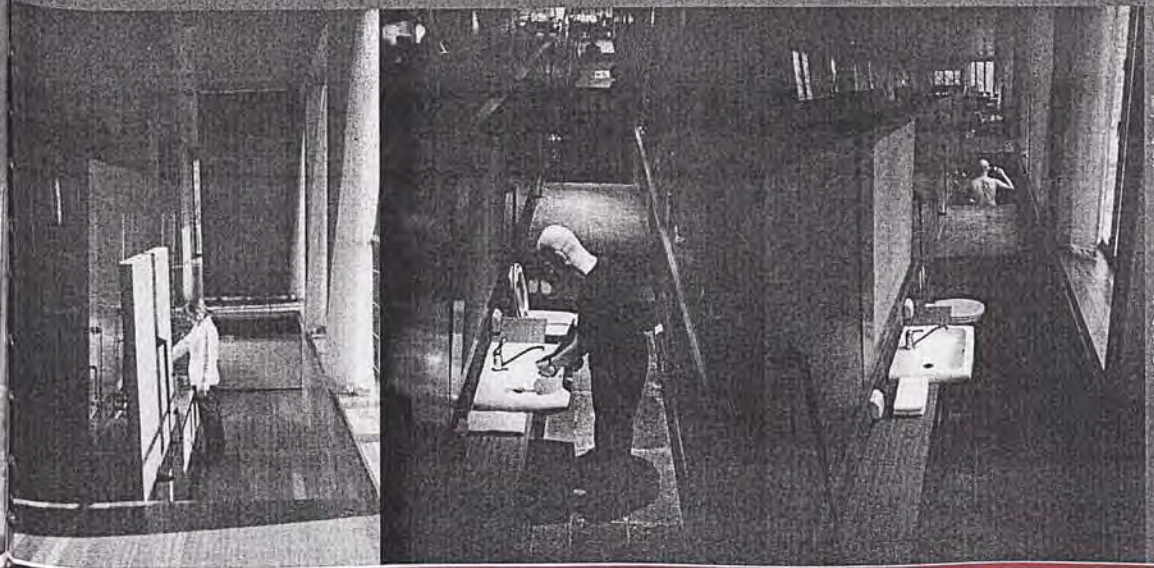




SOUTH ELEVATION



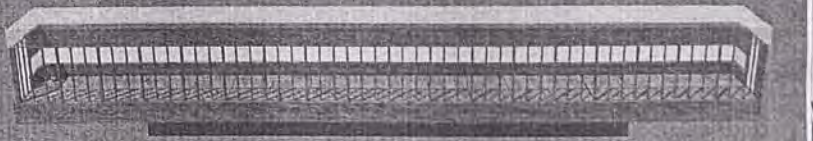
NORTH ELEVATION



STRUCTURE
Cantilevered steel structure over the concrete base
混凝土底座上是懸支架結構。

BASE
The lower stratum of various chambers
底層是一個個房間。

FLOOR PLANE
The main floor with an uninterrupted space of 44m x 5m when all the floor panels are closed
把地板全關上，地面面積44米X5米。

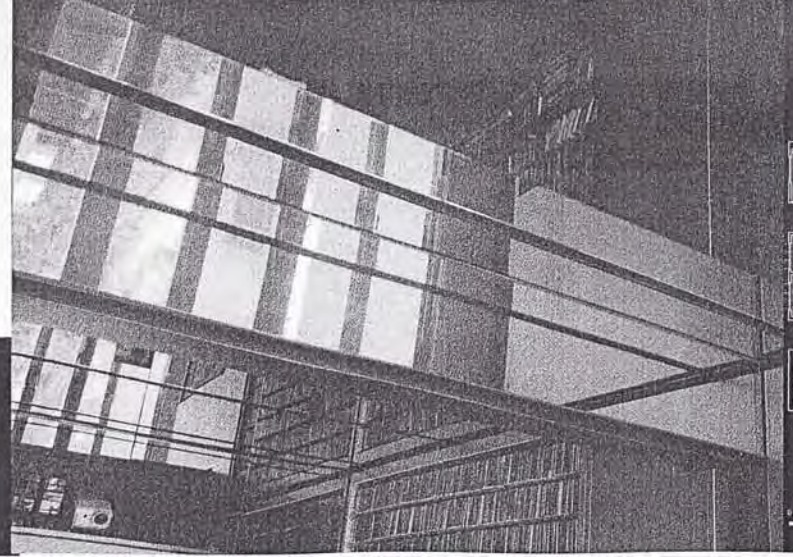


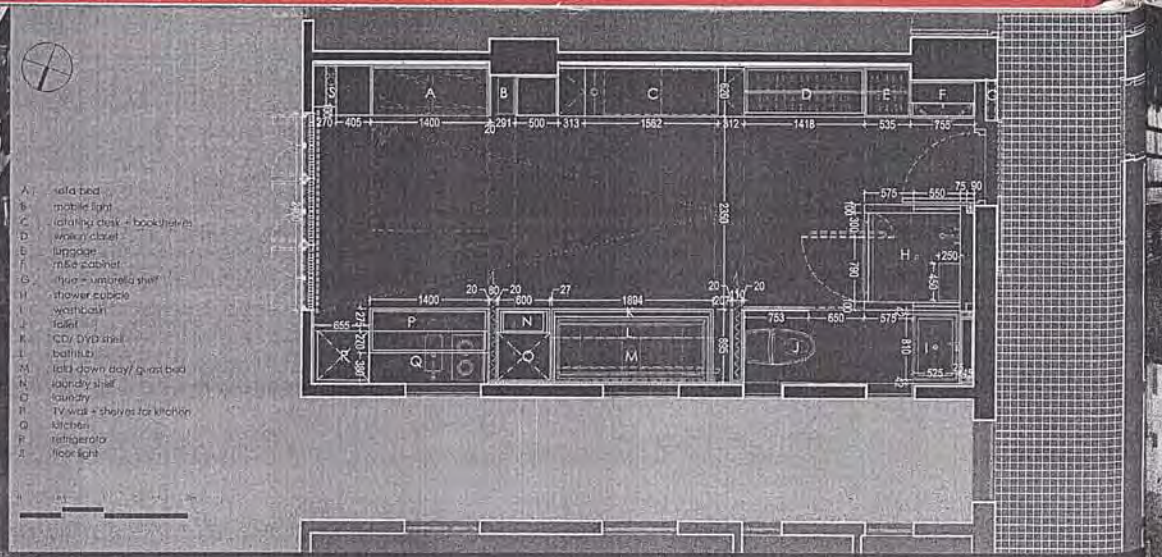
SECTION
A longitudinal section indicating the undulating topography with activities partly exposed and concealed
拉開或收起隔板，劃分各種活動空間。

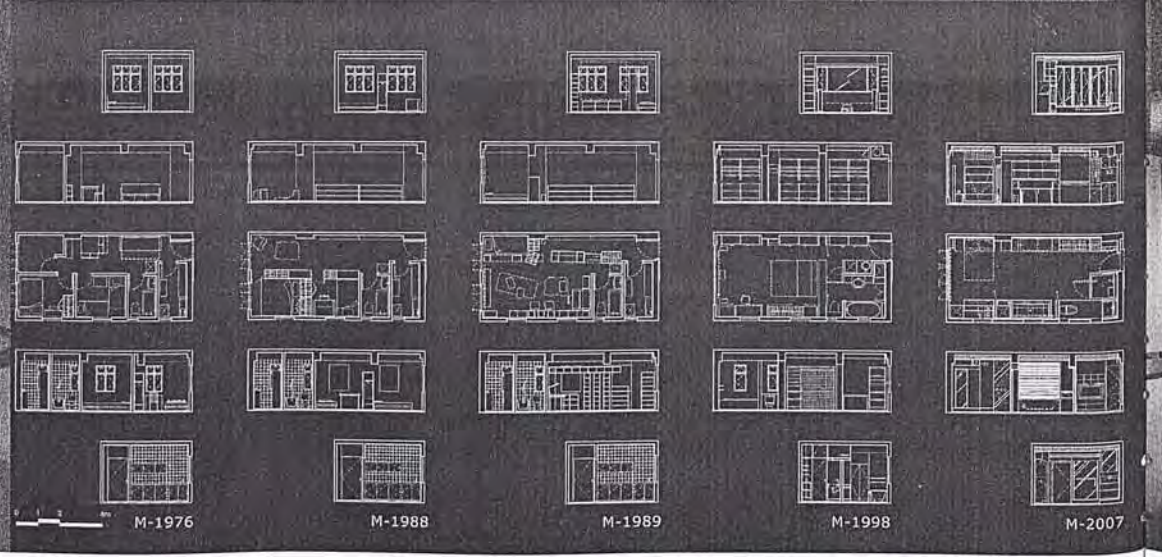
06

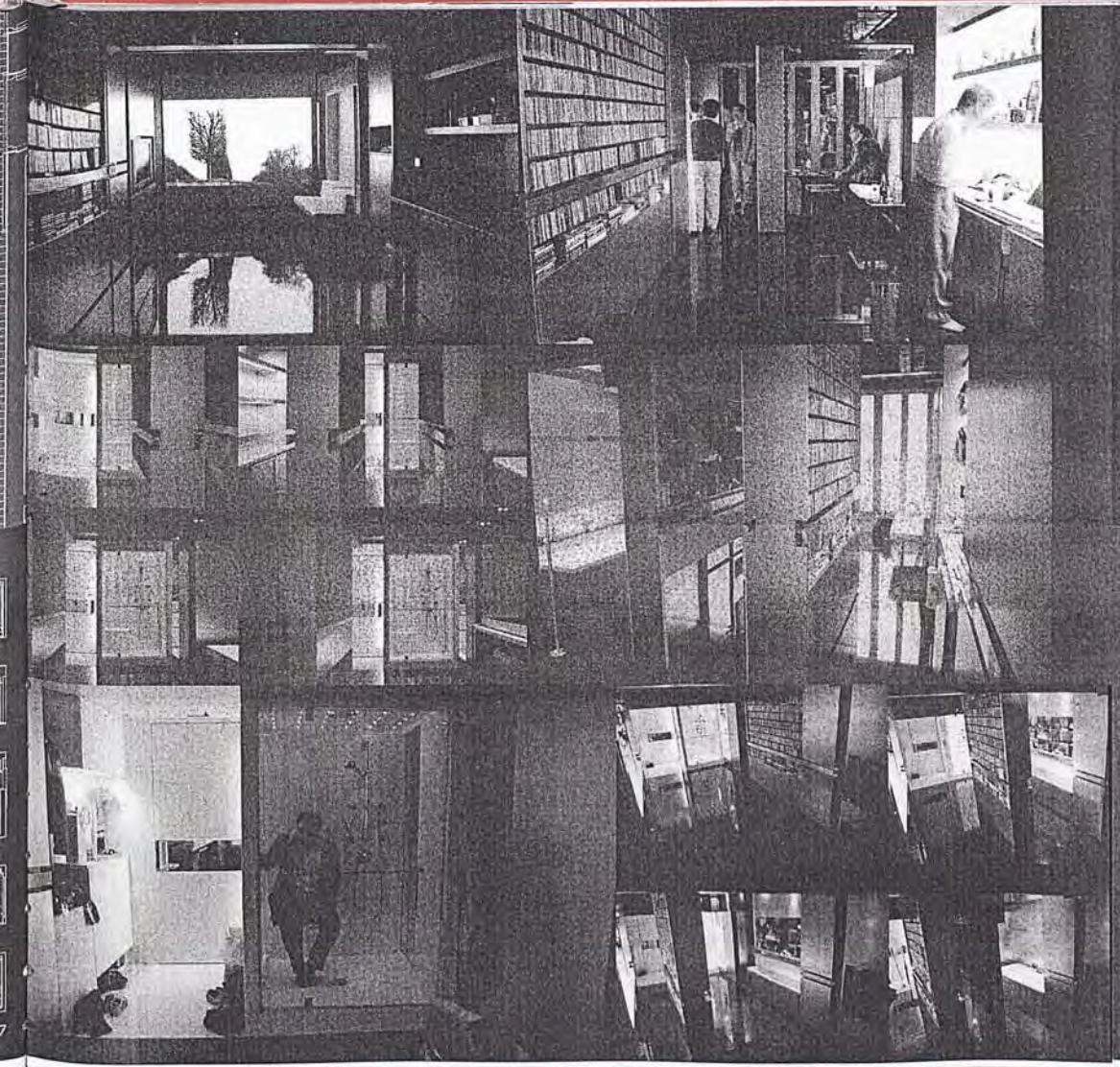
Suitcase concept -
House / Collective Housing
My 32m² apartment

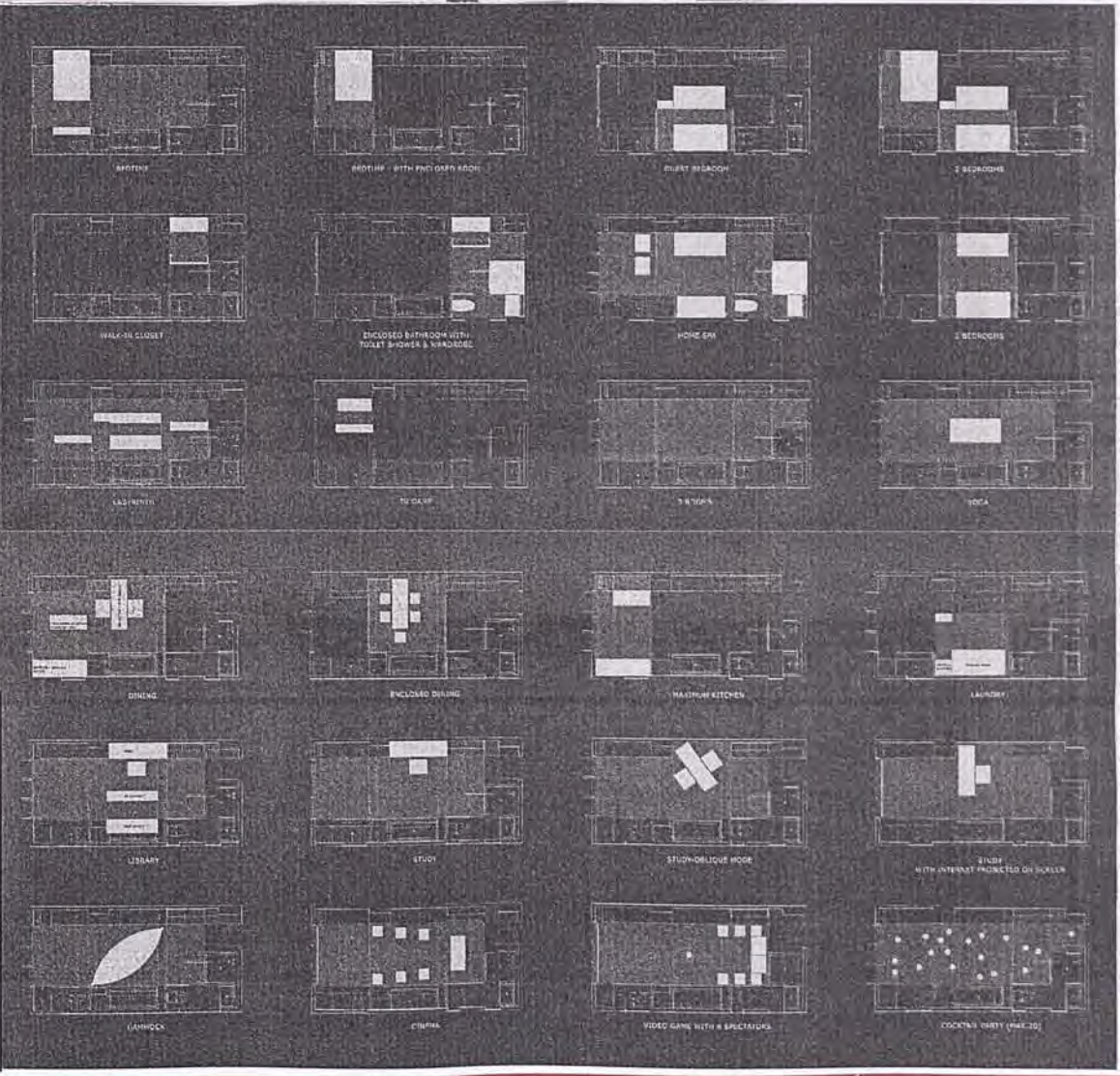
by Gary Chang 2007
Tenement building along
the Victoria Habour near
Swire dockyard
Hong Kong









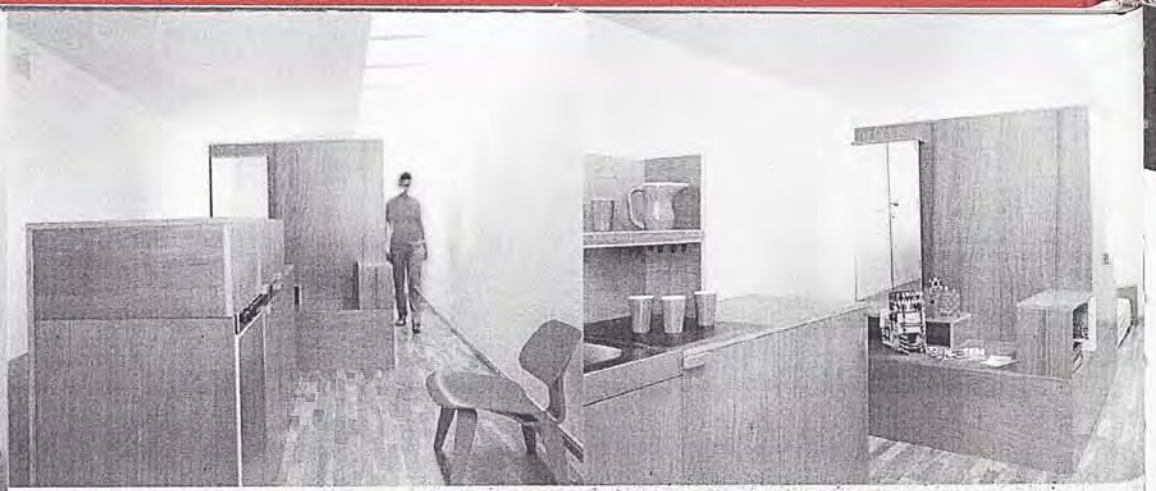

BEDTIME
BEDTIME - WITH PINCUSHION ROOM
GUEST BEDROOM
2 BEDROOMS
WALK-IN CLOSET
ENCLOSED BATHROOM WITH TOILET SHOWER & WARDROBE
HOME GYM
2 BEDROOMS
LAUNDRY
TV ROOM
SHOWER
YOGA
DINING
ENCLOSED DINING
MAXIMUM KITCHEN
LAUNDRY
LIBRARY
STUDY
STUDY-OBLIQUE MODE
STUDY
HAMMOCK
CINEMA
VIDEO GAME WITH 8 SPECTATORS
COCKTAIL PARTY (MAX. 20)

07

Furniture arrangement

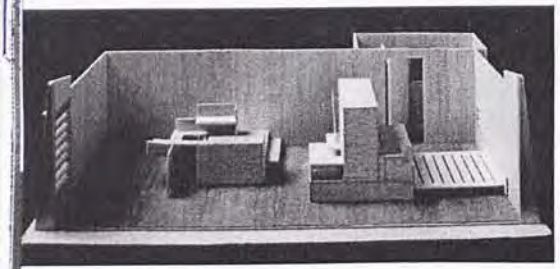
House in a suitcase

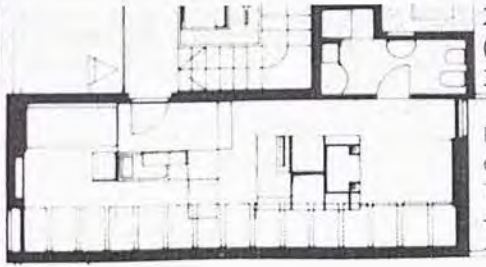
by Eva Prats and Ricardo Flores with Frank Stahi
Barcelona, Spain



Kitchem Trunk
2(L) x 1.6(W) x 1.2m(H) fold-out table, hinged shelf

BedroonTrunk
pull-out double bed, closet's door as folding screen





27m²
(290 sq ft)
3 x 3 x 9m

Purpose-designed Trunk
-bedroom
-kitchen

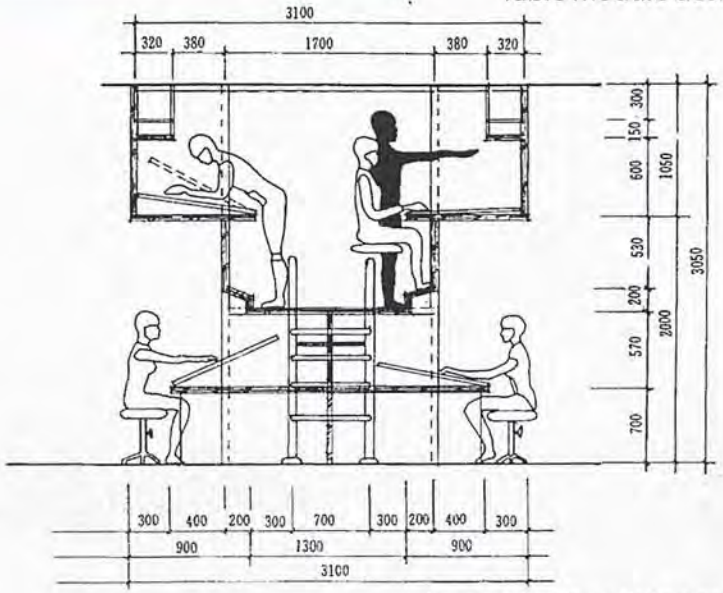
08

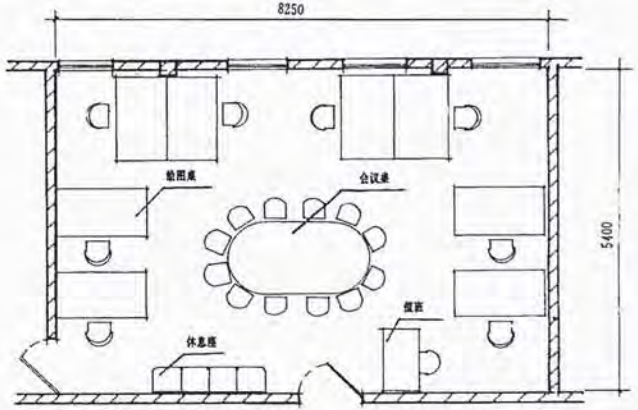
Furniture arrangement

High-efficient space workshop design

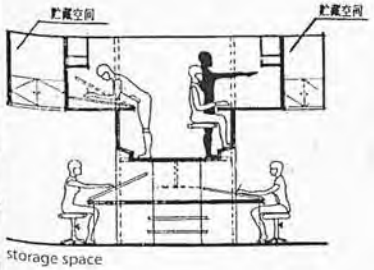
by Bao Jiasheng 1998
Center of Open Building Research And Development,
School of Architetcure,
Southeast University,
China

Table module design



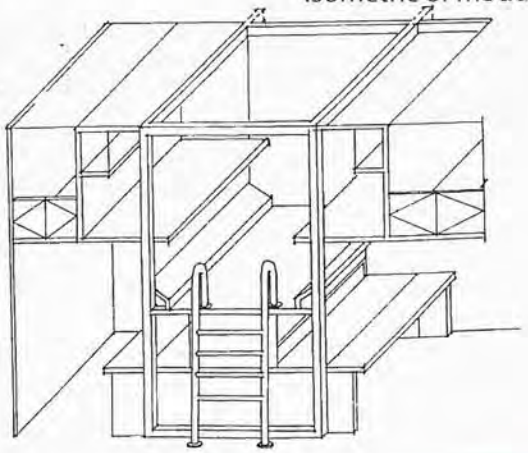


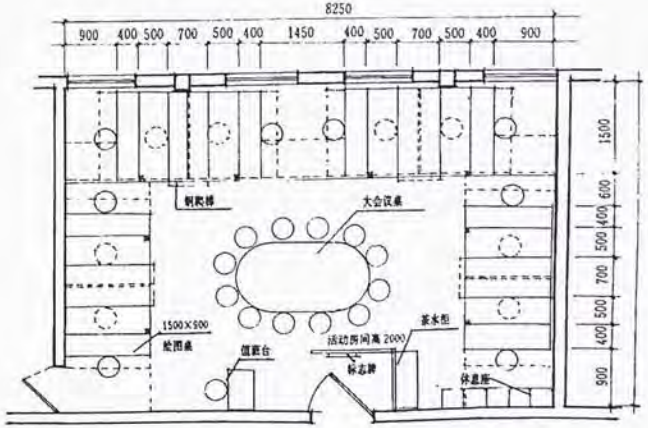
Original workshop layout plan - 8 desks
size: 8250(L) x 5400(W) x 3050(H)
area: 45 sqm



storage space

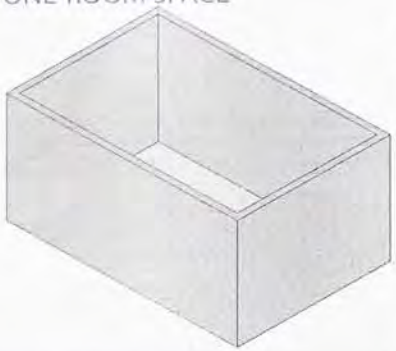
Isometric of module design





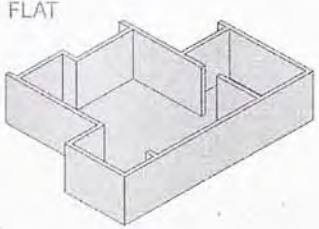
Revised workshop layout plan - 16 desks
increased by 200%

01 ONE-ROOM SPACE

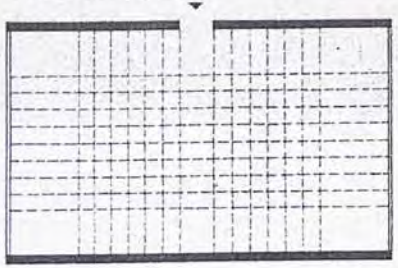


+ 1 kitchen
+ 1 washroom
+ 1 balcony

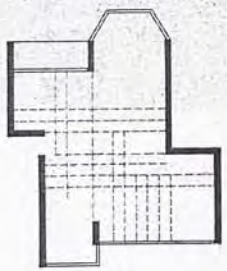
× FLAT



02 REGULAR SHAPE



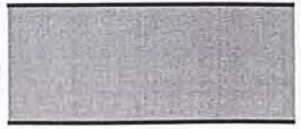
× IRREGULAR SHAPE



03 HIGH FLOOR HEIGHT - MEZZANINE FLOOR

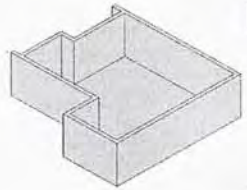
+ 1.4m
+ 2m

× LOW FLOOR HEIGHT 2.3m



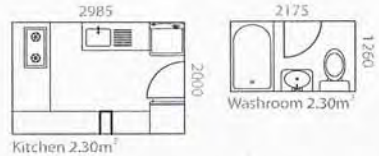
Mass Study

1 $92m^3$ 1-Bedroom Flat



$40m^2$

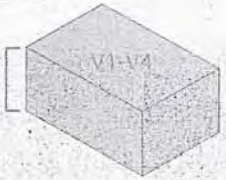
Net Floor Height: 2300

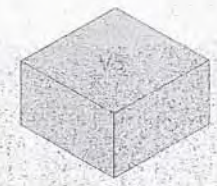


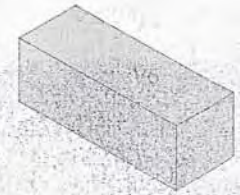
TRANSFORM

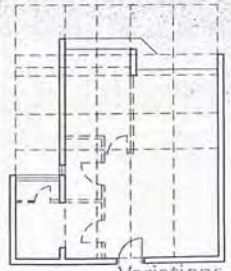
$27m^2$

Net Floor Height: 2400



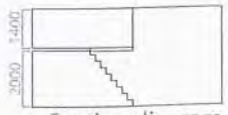




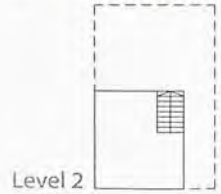


Variations

Level 1



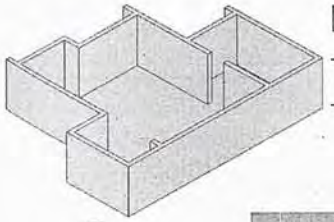
Section diagram



Level 2

Mass Study

2 115m³ 2-Bedroom Flat



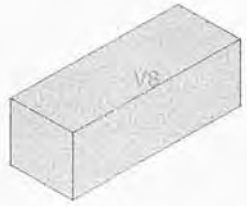
50m²

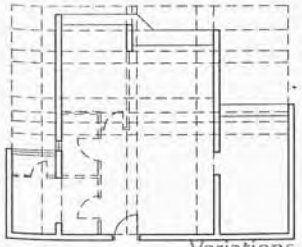
Net Floor Height: 2300

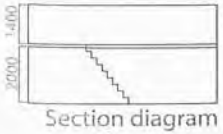
TRANSFORM

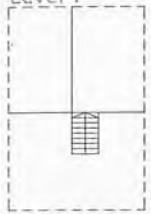
34m²

Net Floor Height: 3400



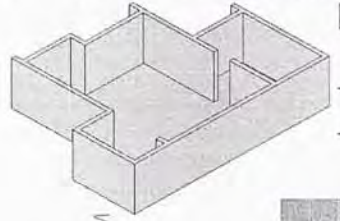






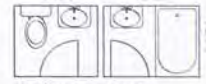
Mass Study

3 138m³ 3-Bedroom Flat



m²

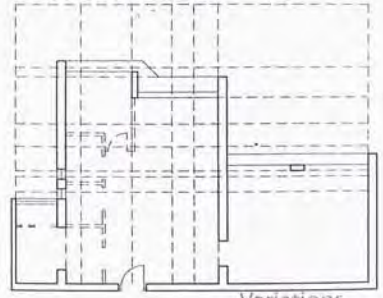
Net Floor Height: 2300

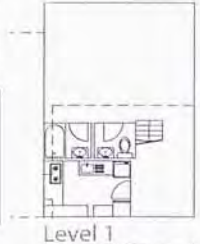


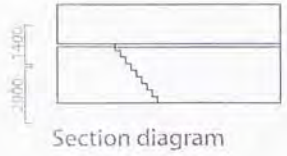
TRANSFORM

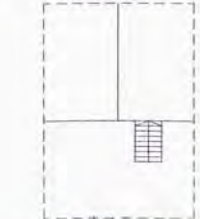
41m²

Net Floor Height: 3400









Proposed Site

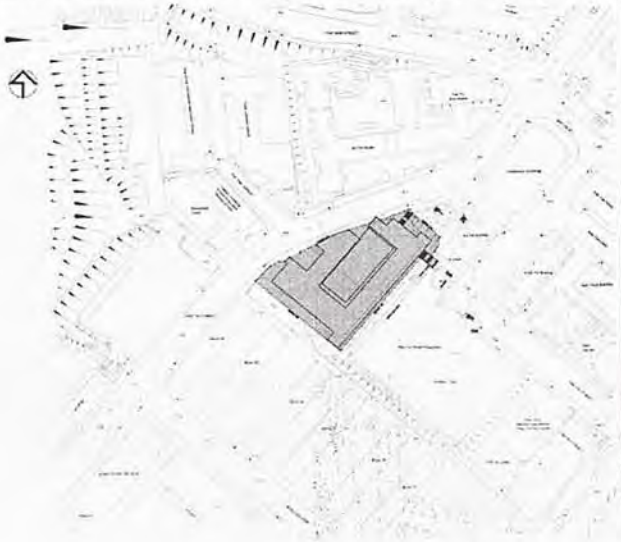
1 Factory Building
Only former Shek Kip Mei (Now JCCAC), Chai Wan and Kowloon Bay factory Building are still existing. Others have been demolished for other development.

The design of these buildings are divided into "H type" and "I type", 7-storey designs, which "H" design with the first resettlement blocks similar to the use of public toilets and bathrooms located between the two wings; and "I Type "is a single-block design, located in the building on both sides of the toilet.

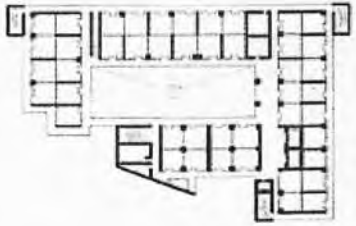
Until 1973, the Housing Authority took over the former Resettlement Department of the eight resettlement factory buildings, and in1973 to 1984,more than 9 factory buildings were built, floors has increased from 7 to 20 multi-storey , and design was changed by the site condition.

2 Industrial building in Hong Kong
Some Artist studios in Fo Tan have been visited to study the net floor height and how the artists organize their space whether if they have made loft space / mezzaine floor in maxizing space and increase sapce efficiency.
- Fo Tan
- Tsuen Wan East
- Tai Kok Tsui

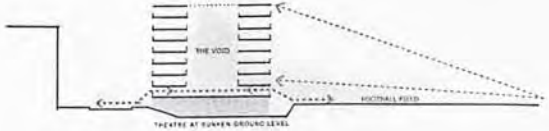
Site 5.1 Former Shek Kip Mei Factory Building (JCCAC) 1977

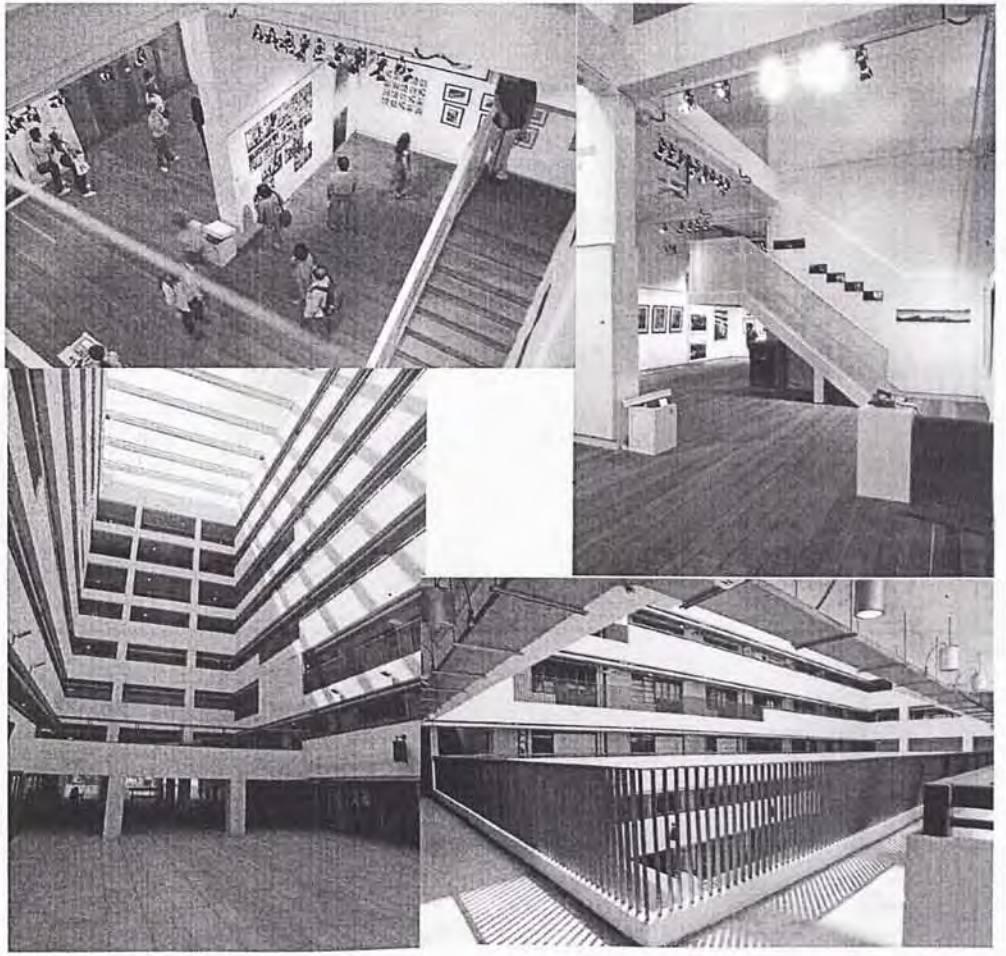


Site Plan

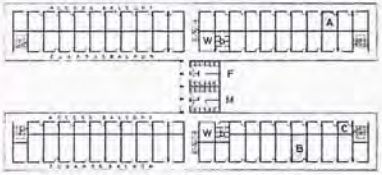


Original Layout Plan and Section





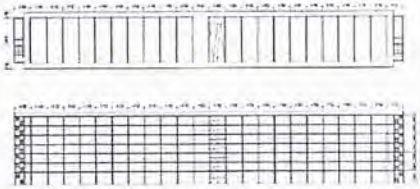
Site 5.2 Chai Wan Factory Building 1959



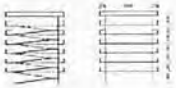
Layout same as Mark 1's plan
- H shaped
- Central Public Washroom

Net Floor Height: 2750
5-storey

Site 5.3 Chai Wan Factory Building 1959

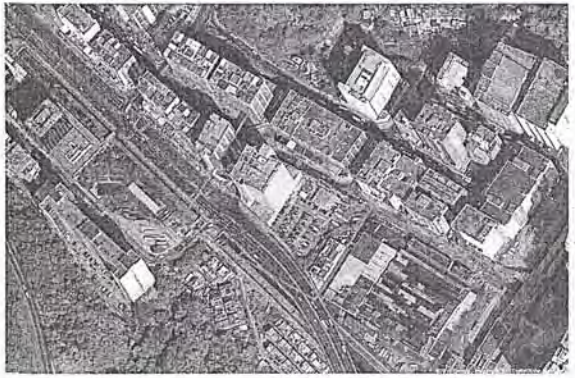


Typical Floor Plan
- No lift
- Washroom at side end
- Flexible Partition Wall



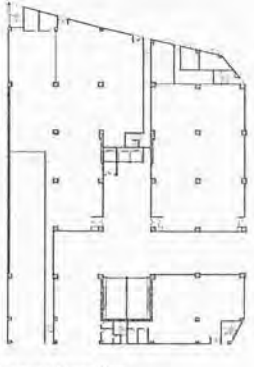
Net Floor Height: 2750
7-storey

Site 5.4 Fo Tan The Unison Industrial Centre 1982

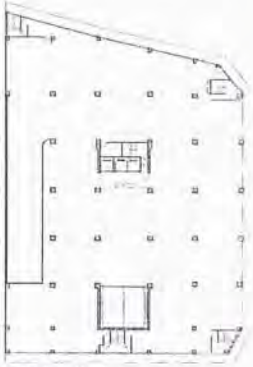


27-31, Au Pui Wan Street, Fo Tan
17-storey

- GF Entrance/ Commercial
- 1F Carpark
- 2F Office/ Warehouse/ Commercial
- 3F Podium Level/ Office
- 4F-16F Office/ Warehouse



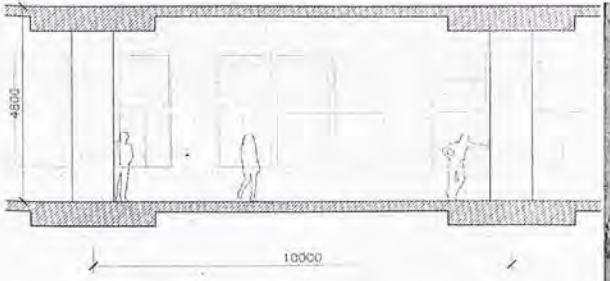
Ground Floor Plan



First Floor Plan

Second Floor Plan

Fourth to Sizteenth Floor Plan



Floor height study- Partial Section

SITE SELECTION CRITERIA - BUILDING WITH HIGHT FLOOR HEIGHT

SITE RESEARCH - INDUSTRIAL BUILDING

The site should have higher net floor height than normal residential buildings for design experimentation. From selection of existing buildings in Hong Kong, only industrial buildings have higher net floor height.
Several types of factory building have been considered as site. They are government-owned factory building and different industrial zones in Hong Kong like Tsuen Wan, Tai Kok Tsui, Fo Tan etc.
Industrial zones with surrounding residential building would also be considered as it shows there is a tendency in transforming industrial zone into residential uses.

THE SITE - FO TAN

This industrial area is located close to East Rail Fo Tan station and is separated from the nearest residential developments by roads.
Planning Department has been advised to rezone a site south of Au Pui Wan Street into comprehensive residential development and commercial development. This site is close to railway station and can be optimize its use as its adjacent site has been rezoned into composite development areas. This site can be as a starting point in transforming the whole Fo Tan area into residential uses.
Some Artist studios in Fo Tan have been visited to study the net floor height and how the artists organize their space whether if they have made loft space / mezzanine floor in maxizing space and increase space efficiency.

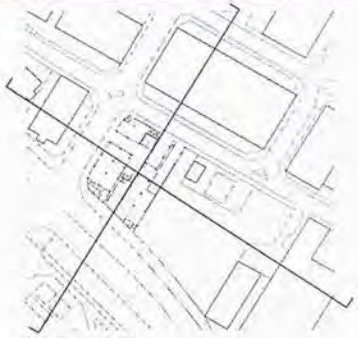
THE BUILDING - UNISON INDUSTRIAL CENTRE

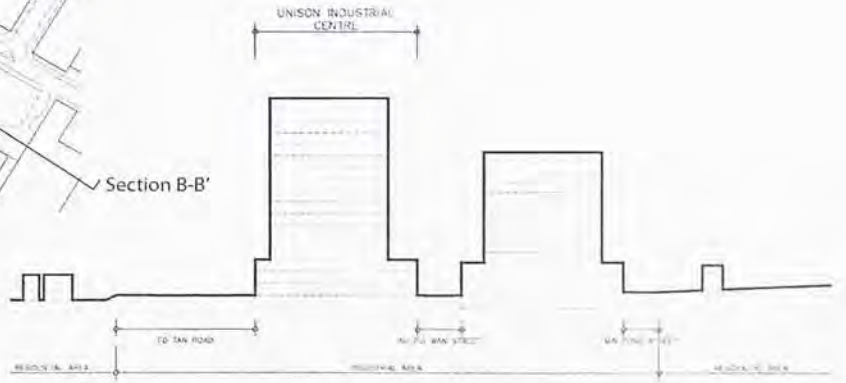
This building is selected as site for design experimentation because it is in the rezoned site proposed by Planning Department for transforming into residential area.
Other than the above advantage, the specific characteristics of this building (geographical location, high accesibility, spacious quality of space, high net floor height) show the potential for transformation.

Year of Completion	1982	
Site Location	27-31 Au Pui Wan Street, Fo Tan	
Site Area	3000 sqm	
Total number of storey	17	
Current Use	G/F	Entrance / Commercial Use
	1/F	Car park
	2/F	Office / Factory / Warehosue
	3/F	Podium / Office / Factory / Warehosue
	4/F - 16/F	Office / Factory / Warehosue
Floor to Floor Height	G/F	5230 mm
	1/F	4400 mm
	2/F	4750 mm
	3/F	4800 mm
	4/F - 16/F	4800 mm

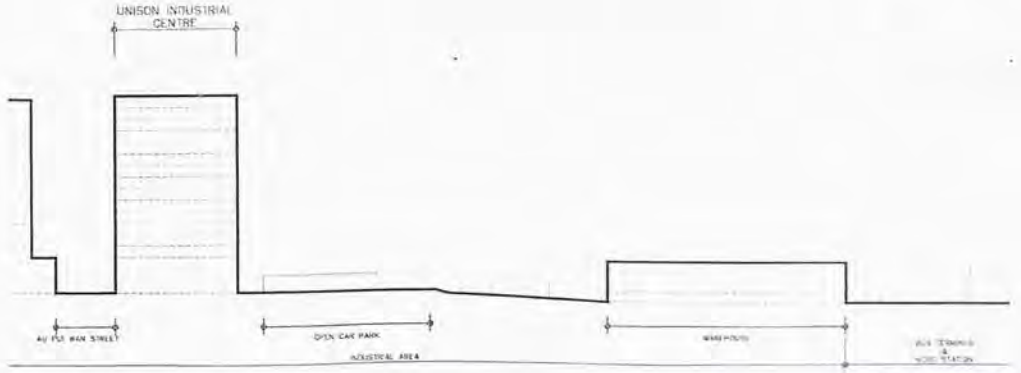
6.2 Site plan 1:2000

6.3 Site condition - Diagramatic Section



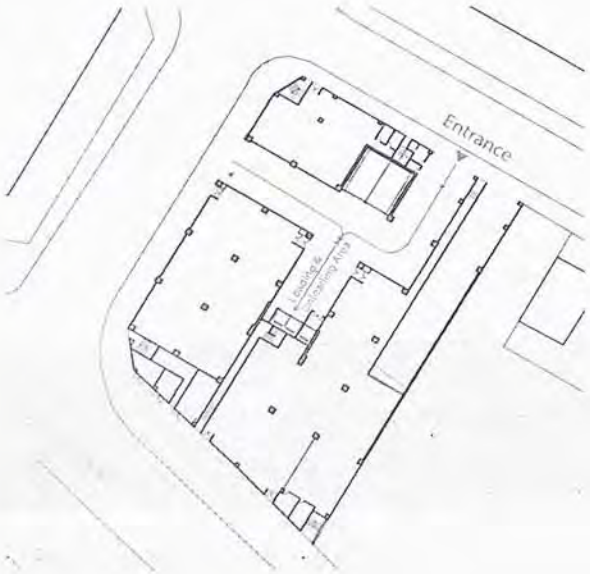


Section A-A'



Section B-B'

6.4 Site studies - circulation



Entrance to 1/F Car park - along Au Pui Wan Street

Ramp to 1/F Car park

Car lift at G/F entrance

6.5 Site condition - Internal Space

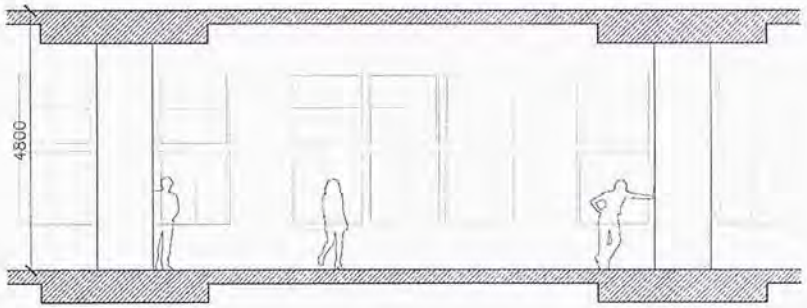
Lift lobby at Typical Floor

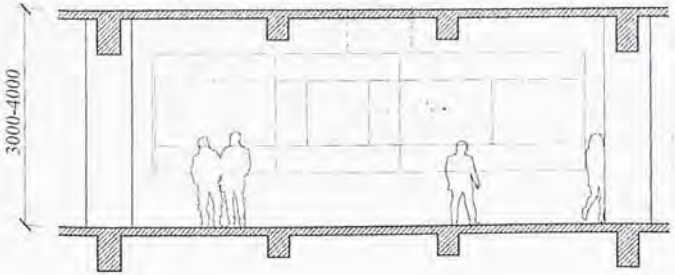
Loading & Unloading Area at Typical Floor

Staicase

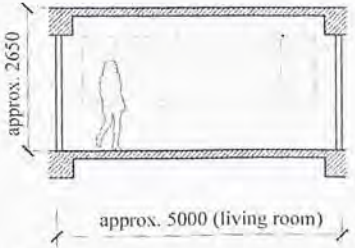
6.6 Site studies - Floor height comparison

Unison Industrial Centre
- using flat beam to maintain higher floor height





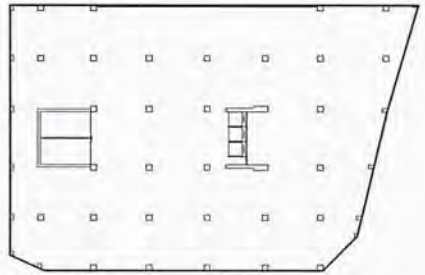
Typical Industrial Building
- lower floor height
- deeper beam



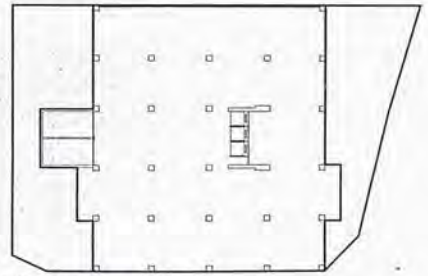
Typical Housing Unit in Hong Kong
- combination of module units

Scale 1:100

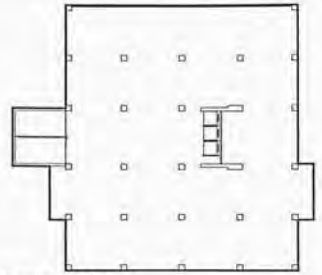
6.7 Site condition - Structural Grid 1 x 1m



G/F - 2/F

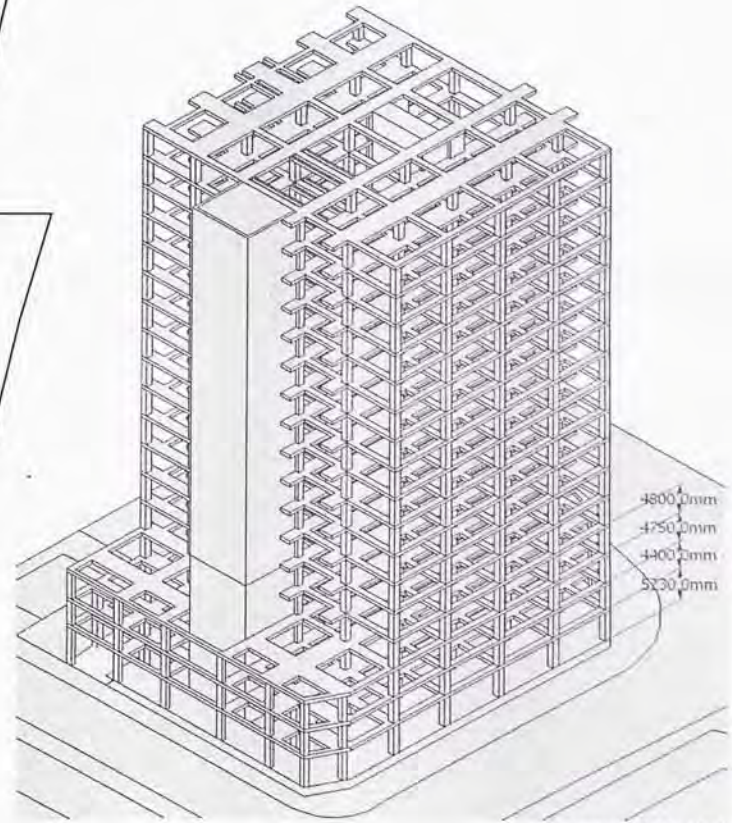


3/F with flat roof



Typical Floor
4/F - 16/F

Scale 1:1000



Structural Model
- isometric view

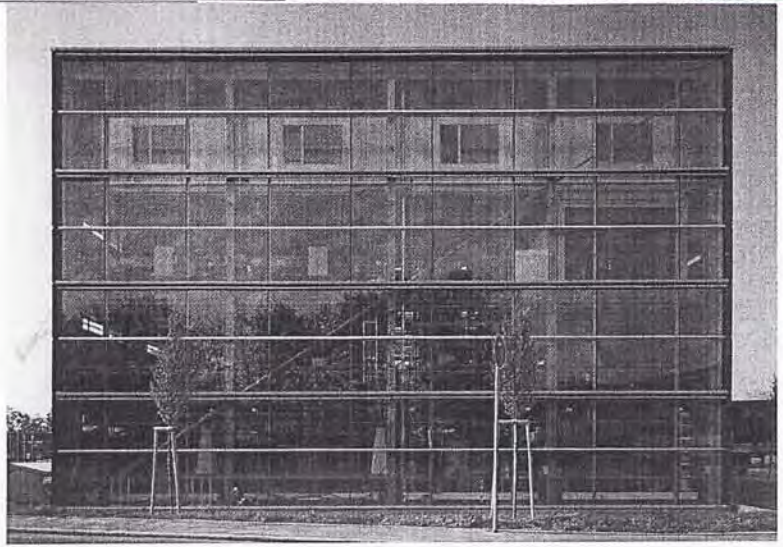
01

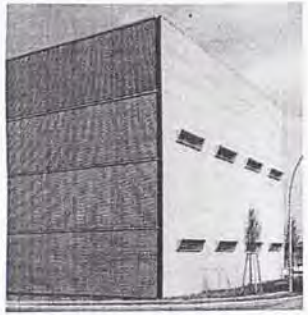
Prefabrication Building System

Skeleton Frame + Module Unit System

Office Block

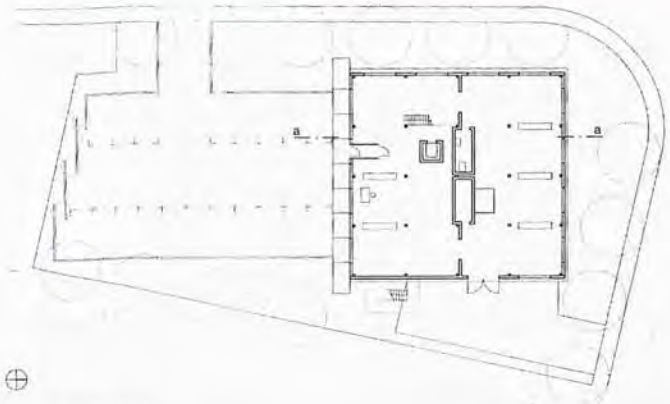
by Dollmann + Partner
Stuttgart, Germany



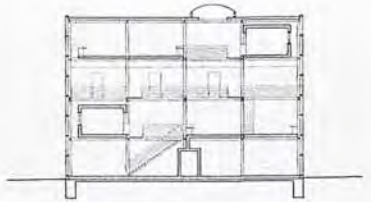


The office building was to contain a variety of spaces, from group working areas to unit offices and conference rooms.

It was a steel structure with simply articulated envelope, consisting of two closed and two glazed facades. The containers that hous the conference rooms and sanitary areas were prefabricated in the factory and hoisted into position in the skeleton-frame structure. The prefabricated floor, wall and stair elements were also inserted within this framework. The entire building is constructed from standard elements in readily available materials.

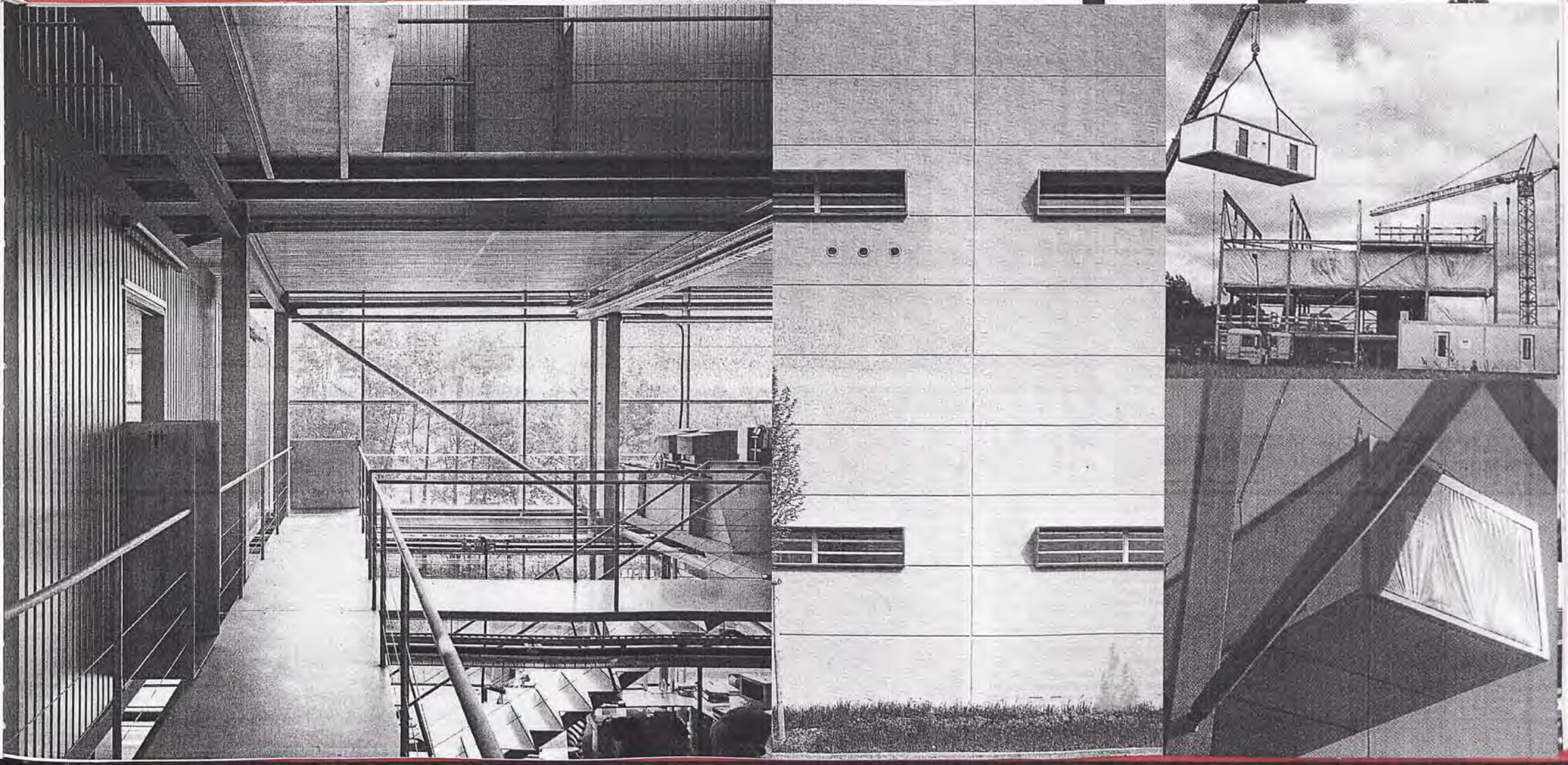


Ground Floor Plan



Section a-a

1st - 3rd Floor Plans



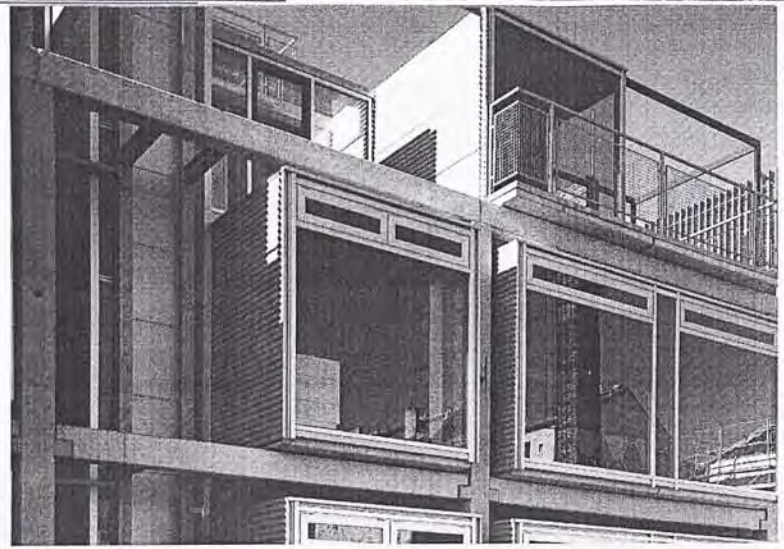
02

Prefabrication Building System

Skeleton Frame + Module Unit System

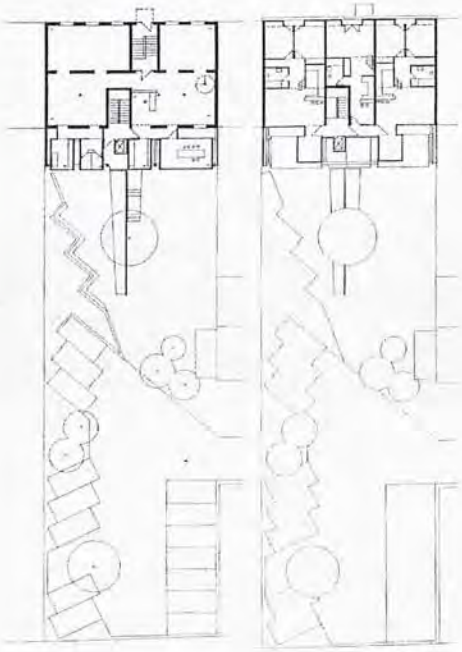
Apartment and Office Building

by Jochen Keim & Klaus Sill
1997
Rathenow, Germany

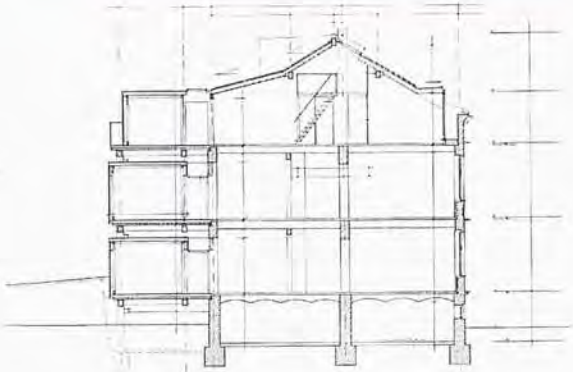


This was a project which 10 containers houses were added on the facade of an existing conventional office building. The concrete framework structure is produced more or less in situ by a local factory that made concrete prefabricated components.

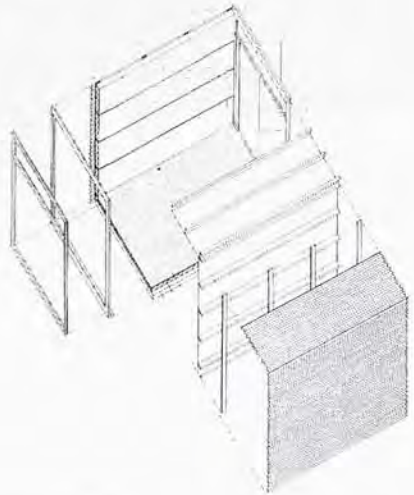
The containers were assembled complete in factory and transported to the site for installing into position of the concrete frame. For the ease of transportation, modules were adapted to the dimensions of standard containers normally used on building sites.



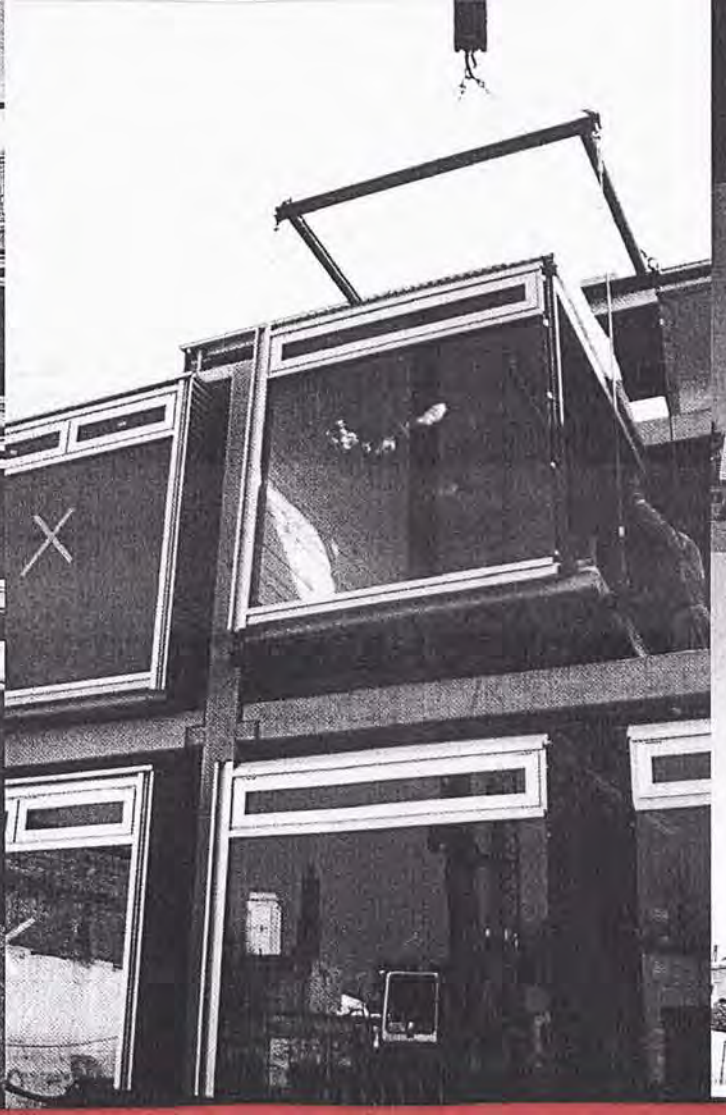
Floor Plans



Section



Isometric View



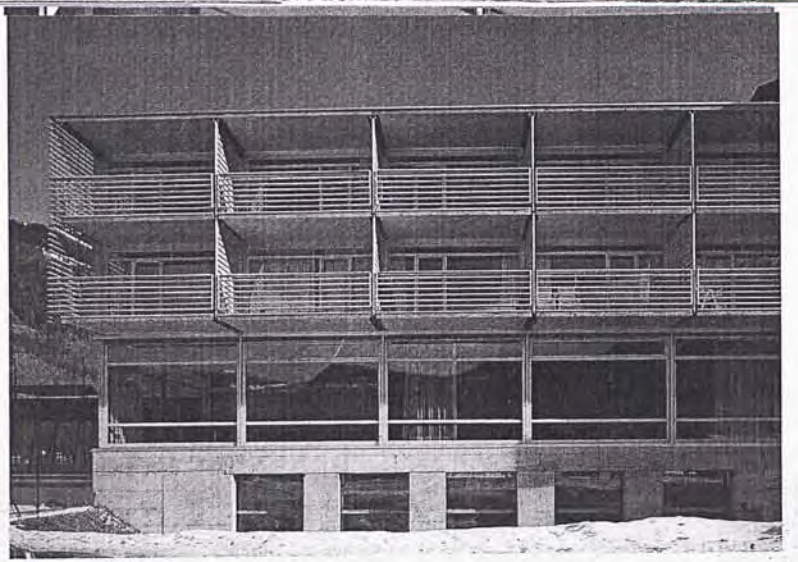
03

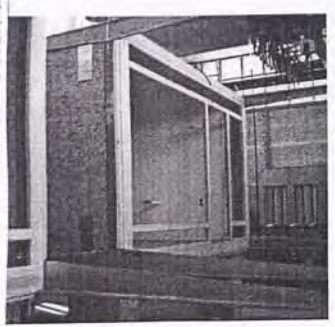
Prefabrication Building System

Stacked Container System

Hotel Post in Bezau

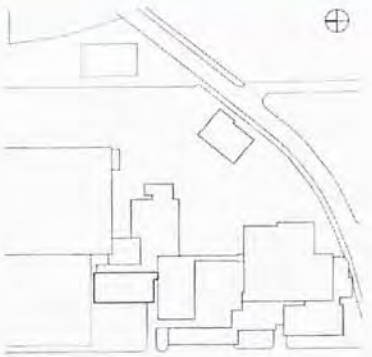
by Kaufmann 96, Dornbirn
1998
Bezau, Austria



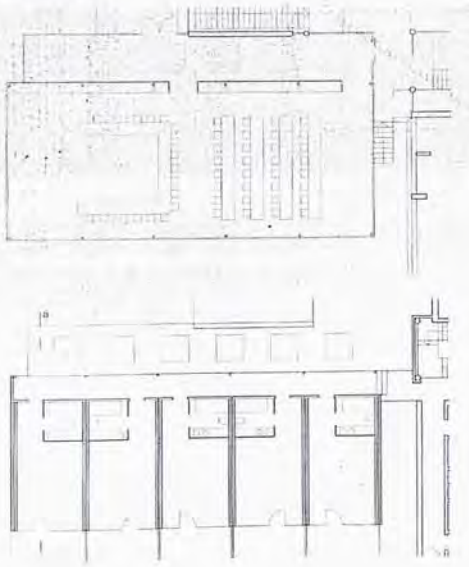


The hotel was to be extended by a further bedroom which a very short construction period was necessary. The building is based on the idea of having a series of prefabricated containers that could be stacked on top of each other.

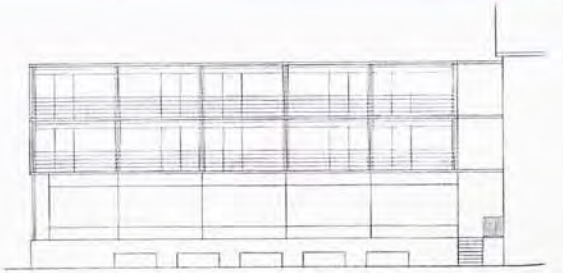
The 7.50 x 4.00 m boxes are self-supporting, therefore no primary structure or additional bracing. were required. Services were laid in the voids between the cells. The project was completed within a short period, which the boxes and roof were erected in two days.



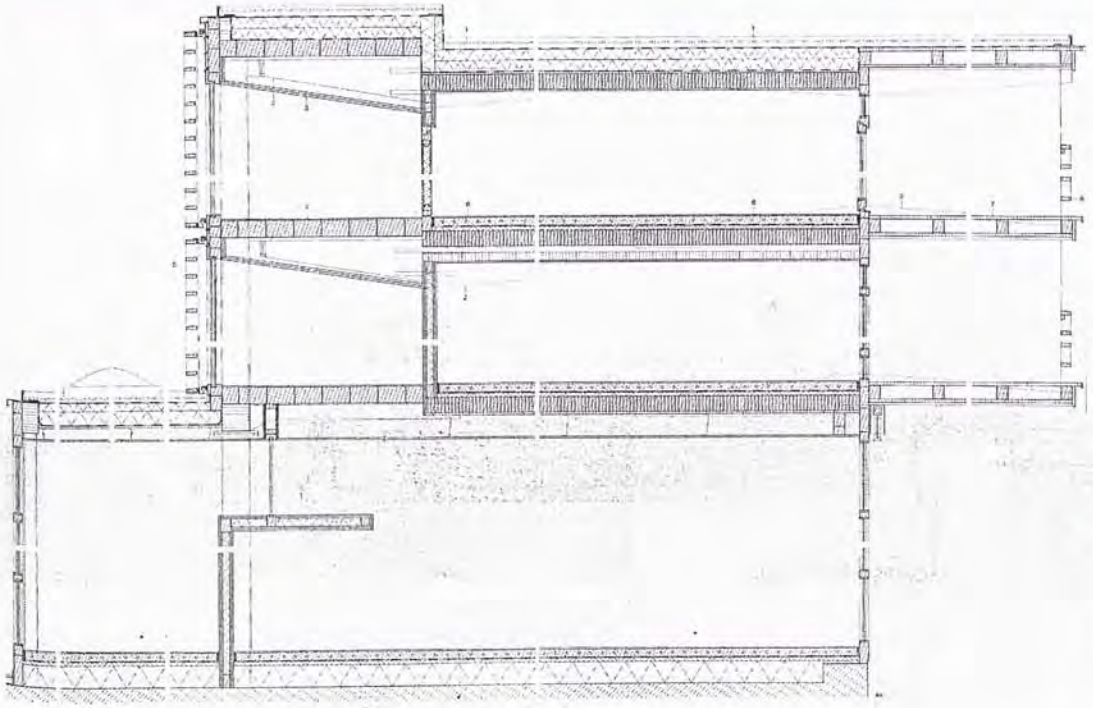
Site Plan
Scale 1:4000



Plans



Elevations



1 *roof construction:*
50 mm bed of gravel
separating layer
plastic roof sealing layer
separating layer
160 mm thermal insulation
vapour barrier
15 mm oriented strand board
115 mm stacked-plank floor
12.5 mm plasterboard

2 *steel fin with connecting flanges welded on*

3 *2× 15 mm fire-resistant plasterboard*

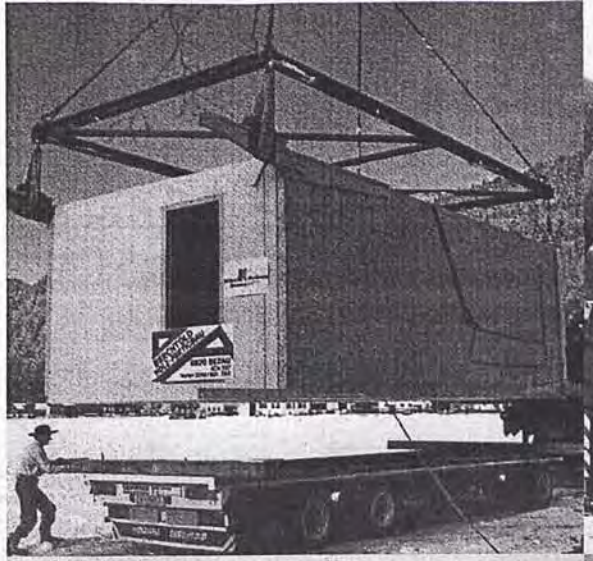
4 *10 mm American cherry parquet flooring*
200/125 mm softwood beams

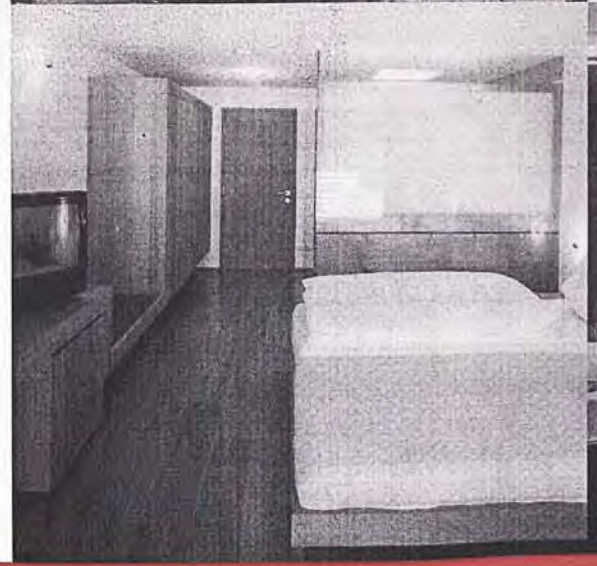
5 *sliding shutter:*
80/25–28 mm silver fir louvres in aluminium angle frame

6 *floor construction:*
10 mm American cherry parquet
60 mm screed around underfloor heating
polythene sheeting
30 mm impact-sound insulation
115 mm stacked-plank floor
50 mm cavity
60 mm three-ply laminated sheeting
12.5 mm plasterboard

7 *glued balcony slab:*
26 mm three-ply laminated sheeting
80/100 mm softwood bearers
20 mm three-ply laminated sheeting

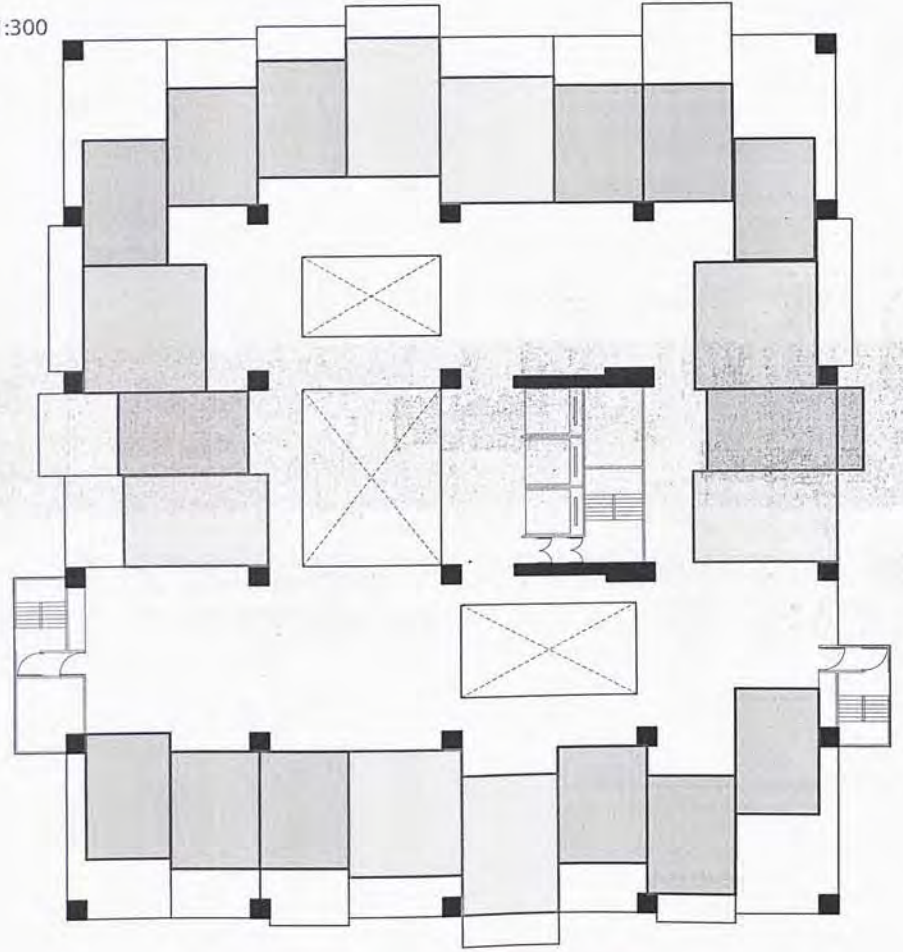
8 *fixed larch louvres*



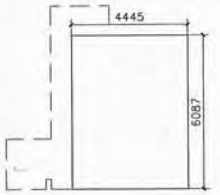


Typical Floor Plan 1:300
LEVEL 1

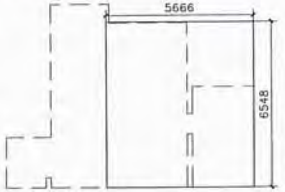
Units distribution
1-bedroom 14
2-bedroom 6
3-bedroom 2

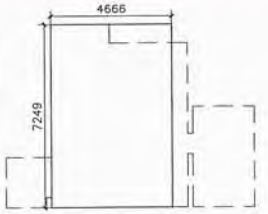


1-Bedroom Flat

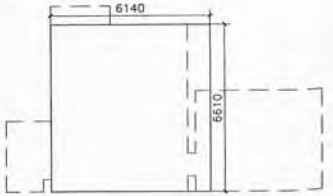


2-Bedroom Flat

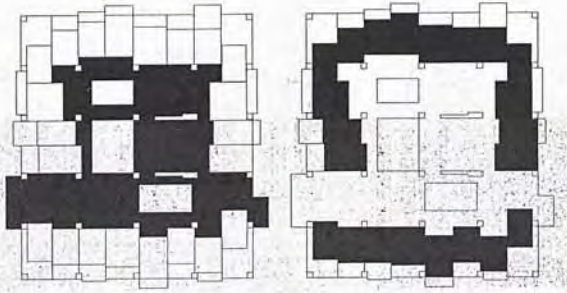




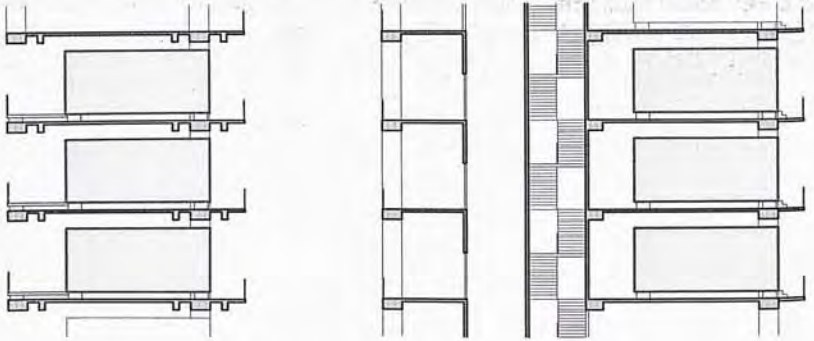
3-Bedroom Flat



Relationship of
Unit and Open Space



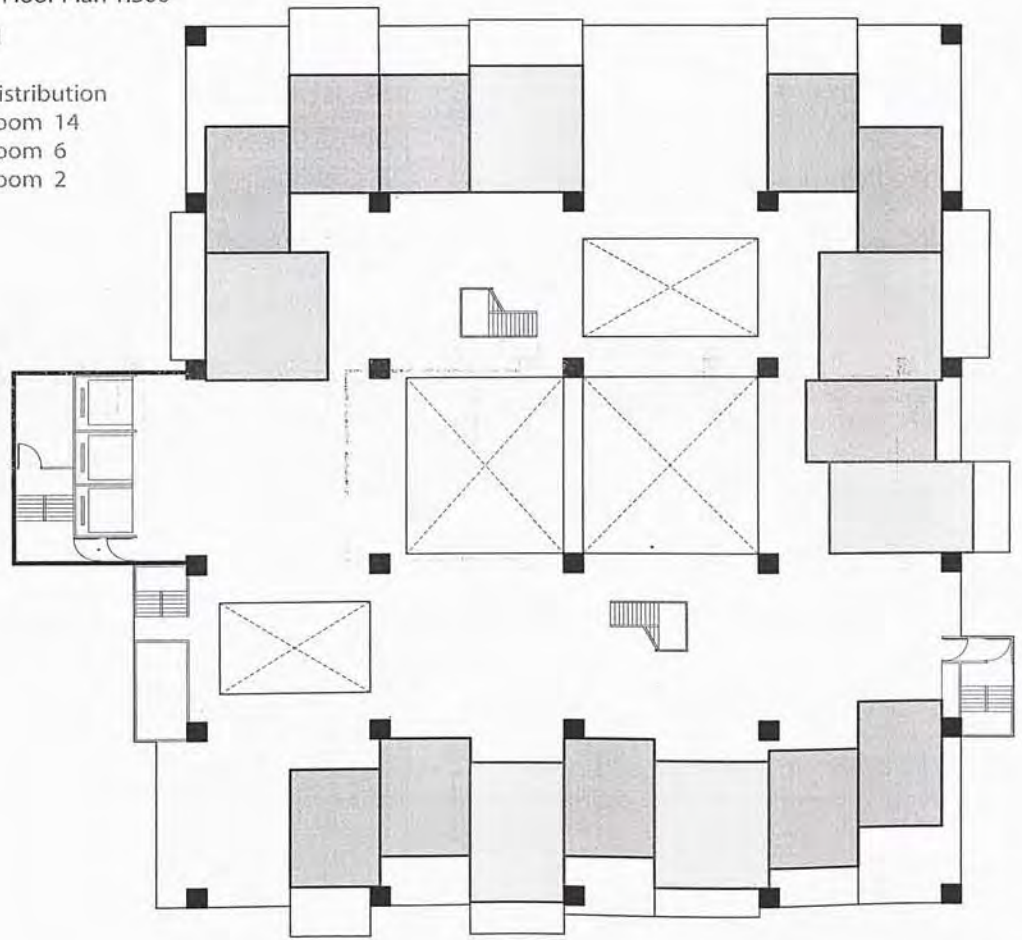
Section A



Grouping every 2 floors
Lift core shifts to existing car lift location
Typical Floor Plan 1:300

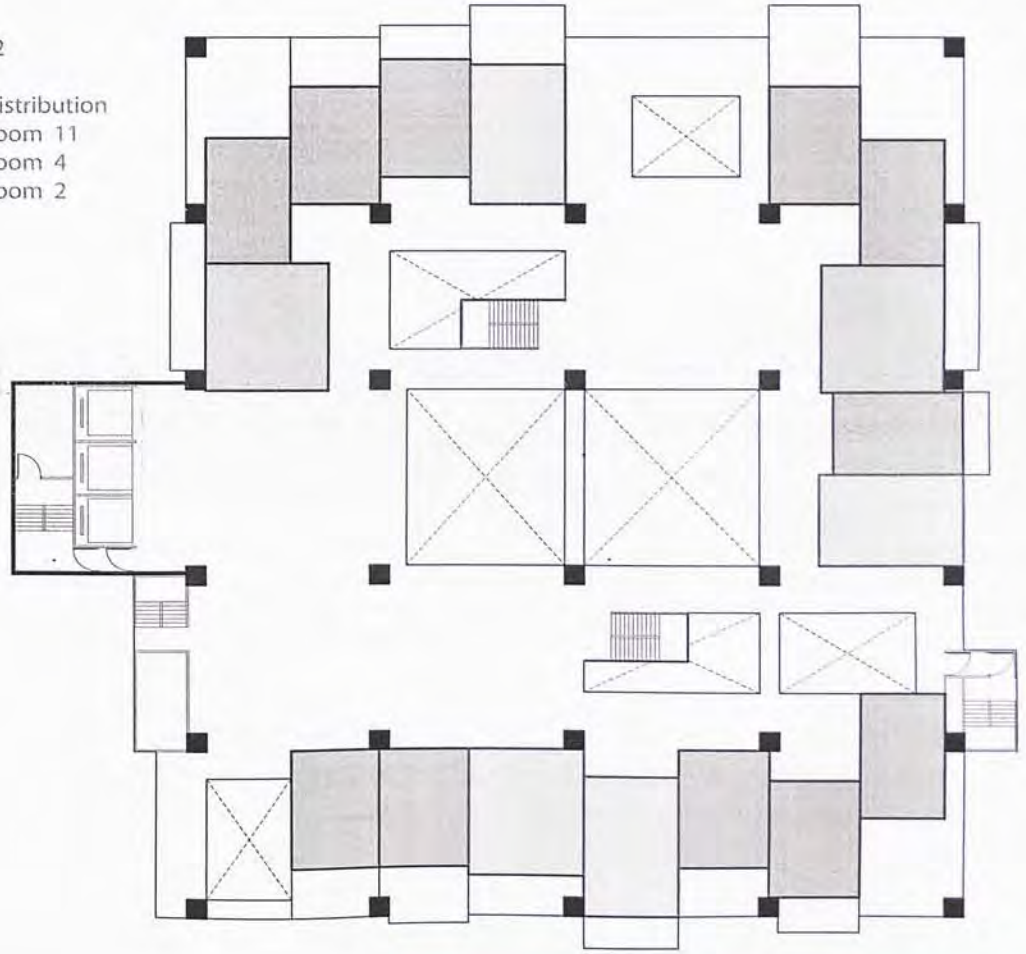
LEVEL 1

Units distribution
1-bedroom 14
2-bedroom 6
3-bedroom 2

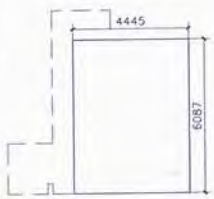


LEVEL 2

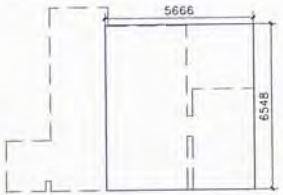
Units distribution
1-bedroom 11
2-bedroom 4
3-bedroom 2

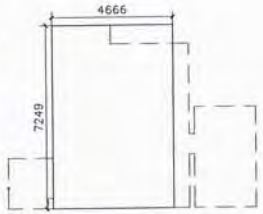


1-Bedroom Flat

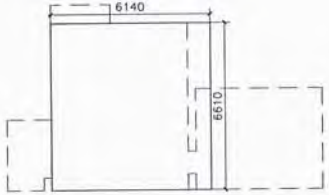


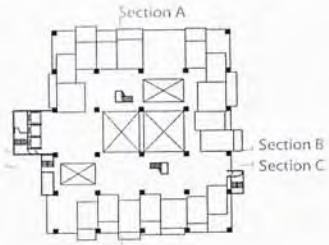
2-Bedroom Flat



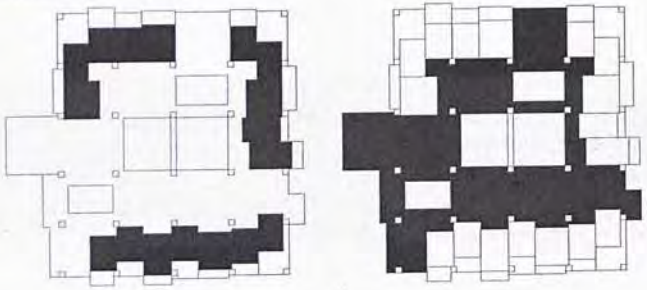


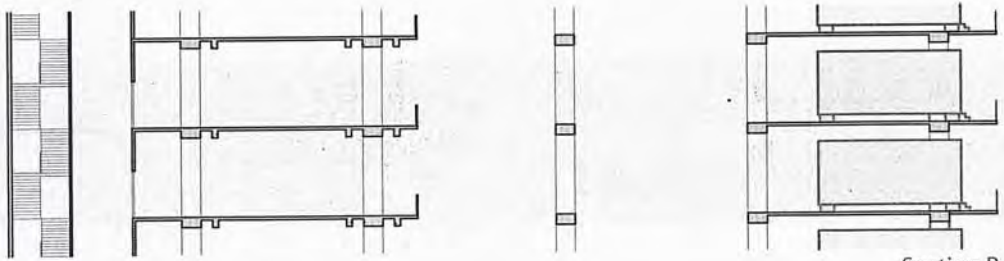
3-Bedroom Flat

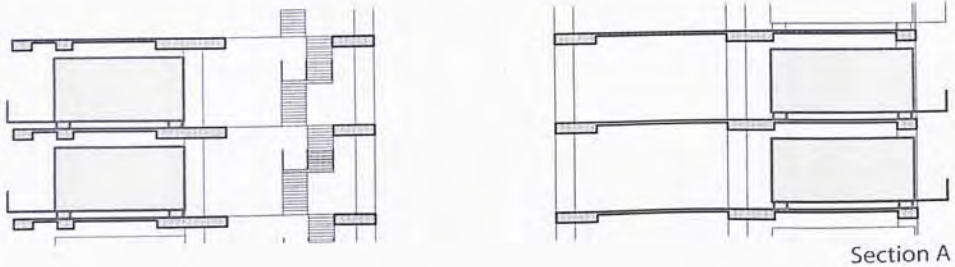


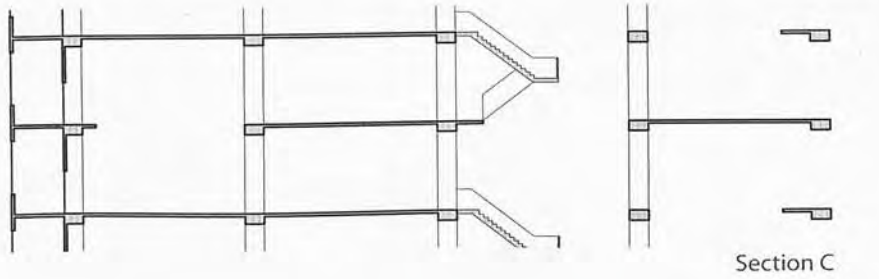


Relationship of
Unit and Open Space





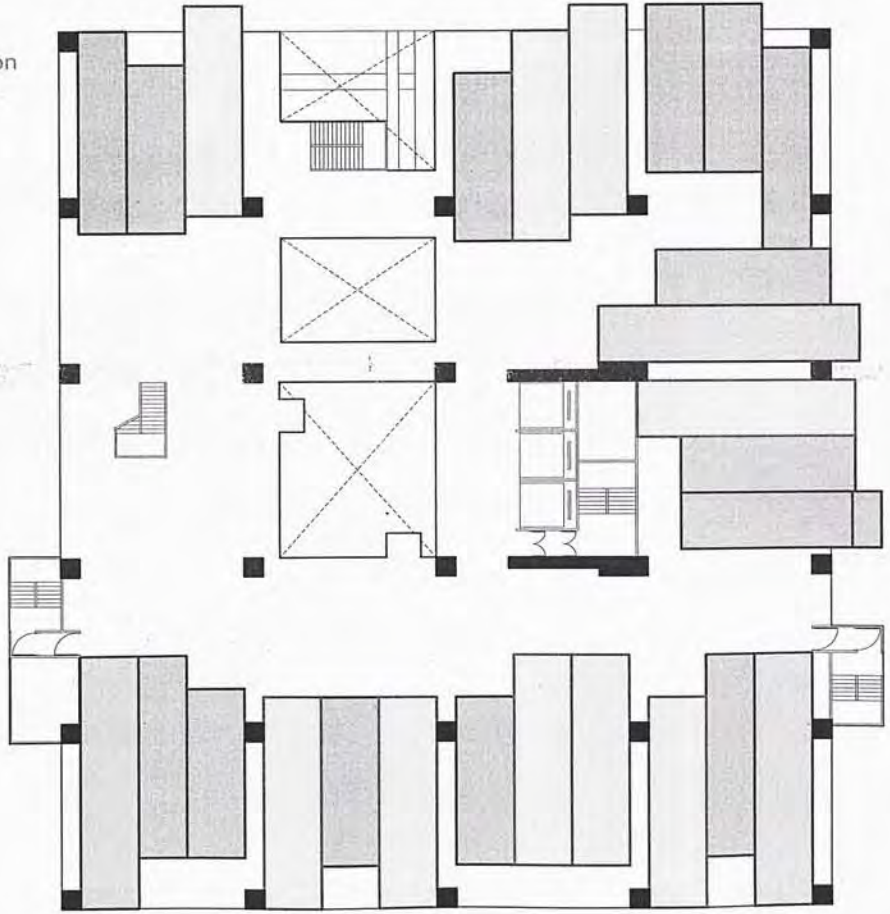




Grouping every 3 floors
Typical Floor Plan 1:300

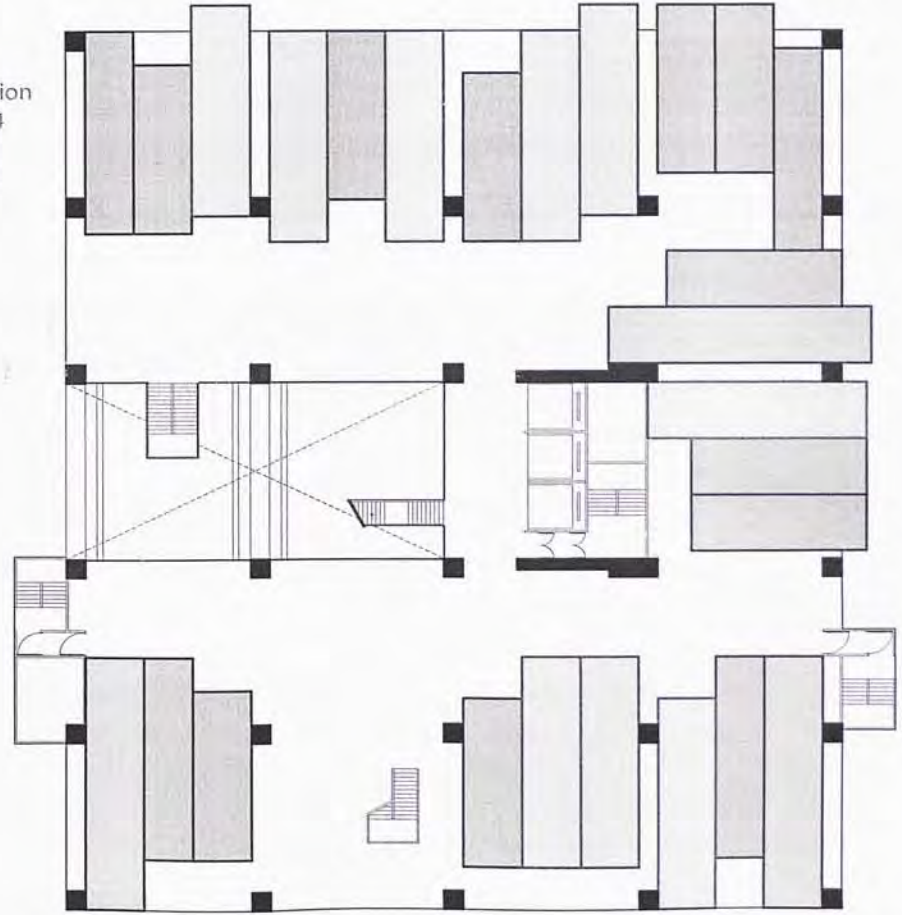
LEVEL 1

Units distribution
1-bedroom 14
2-bedroom 9
3-bedroom 3



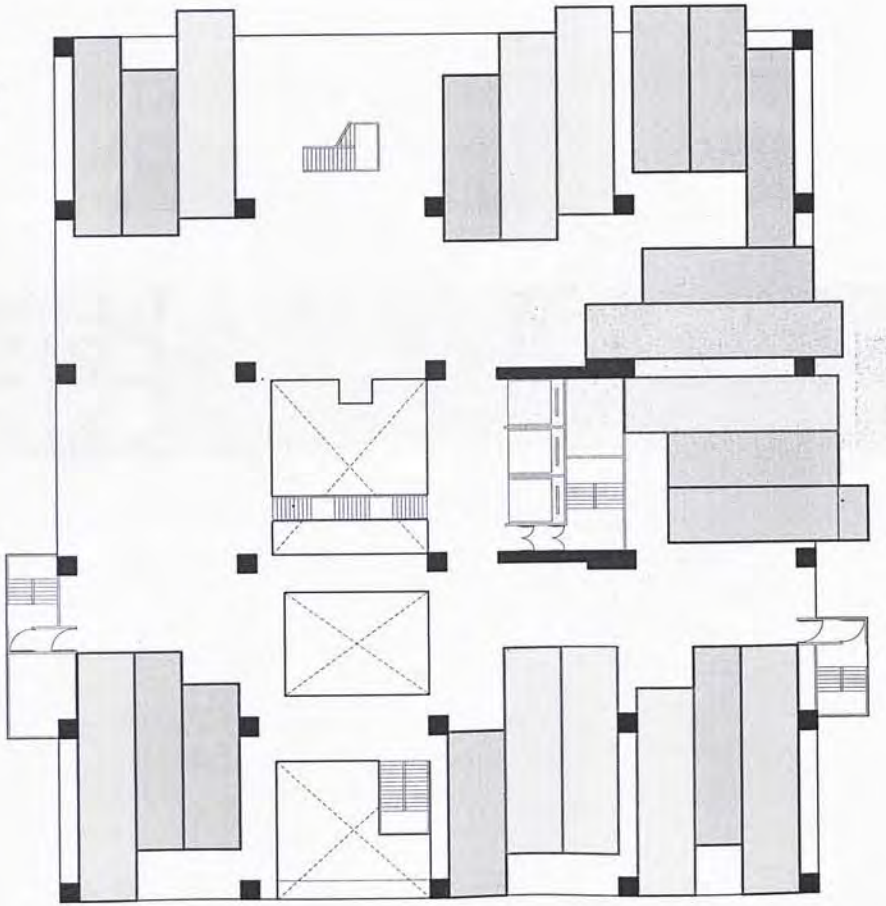
LEVEL 2

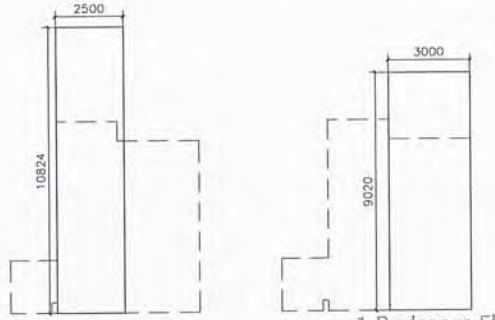
Units distribution
1-bedroom 14
2-bedroom 9
3-bedroom 3



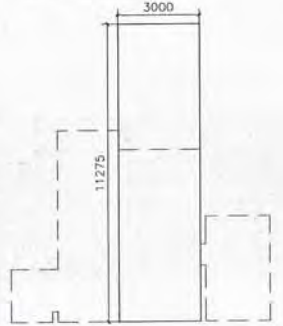
LEVEL 3

Units distribution
1-bedroom 13
2-bedroom 7
3-bedroom 3

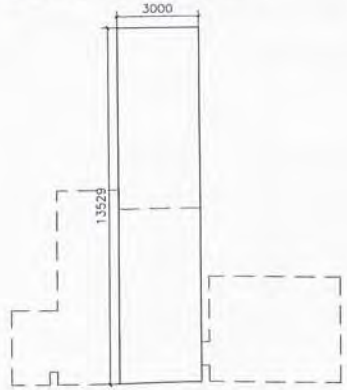




1-Bedroom Flat

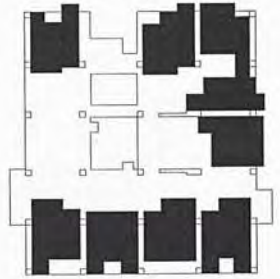


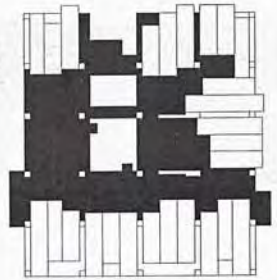
2-Bedroom Flat



1-Bedroom Flat

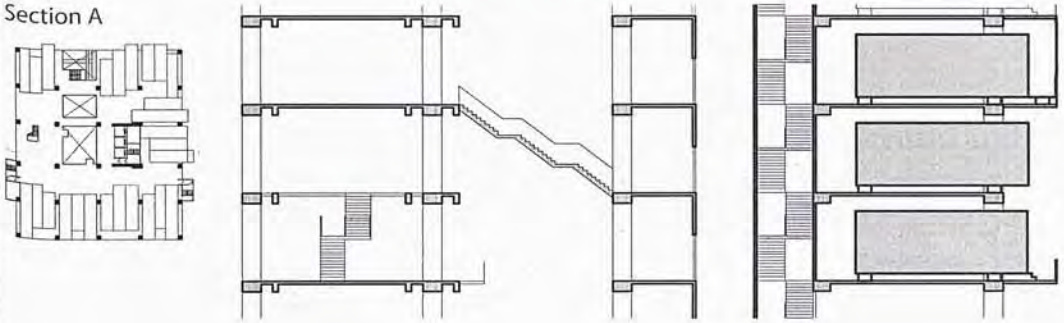
Relationship of
Unit and Open Space



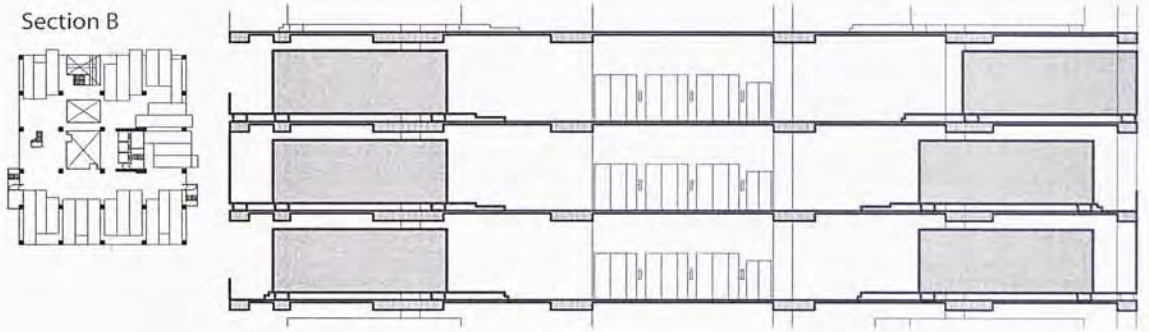


Level 1

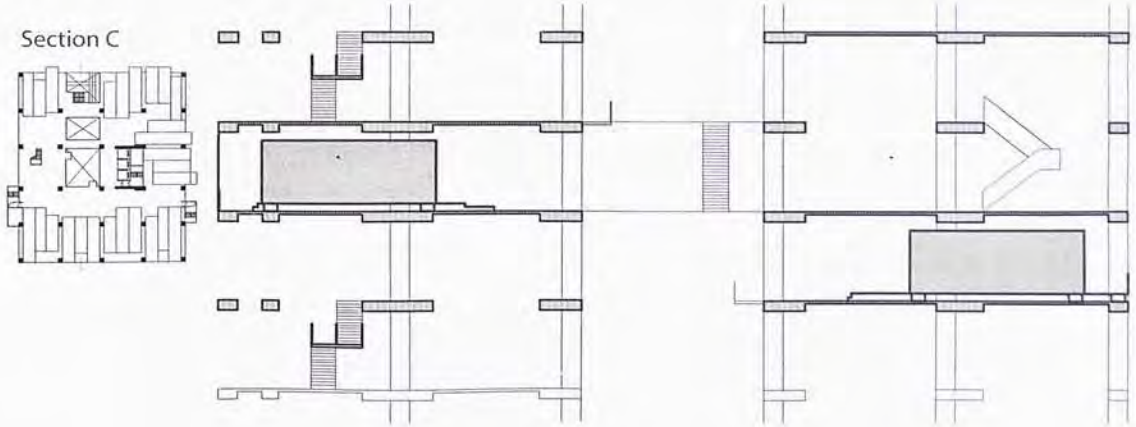
Section A



Section B



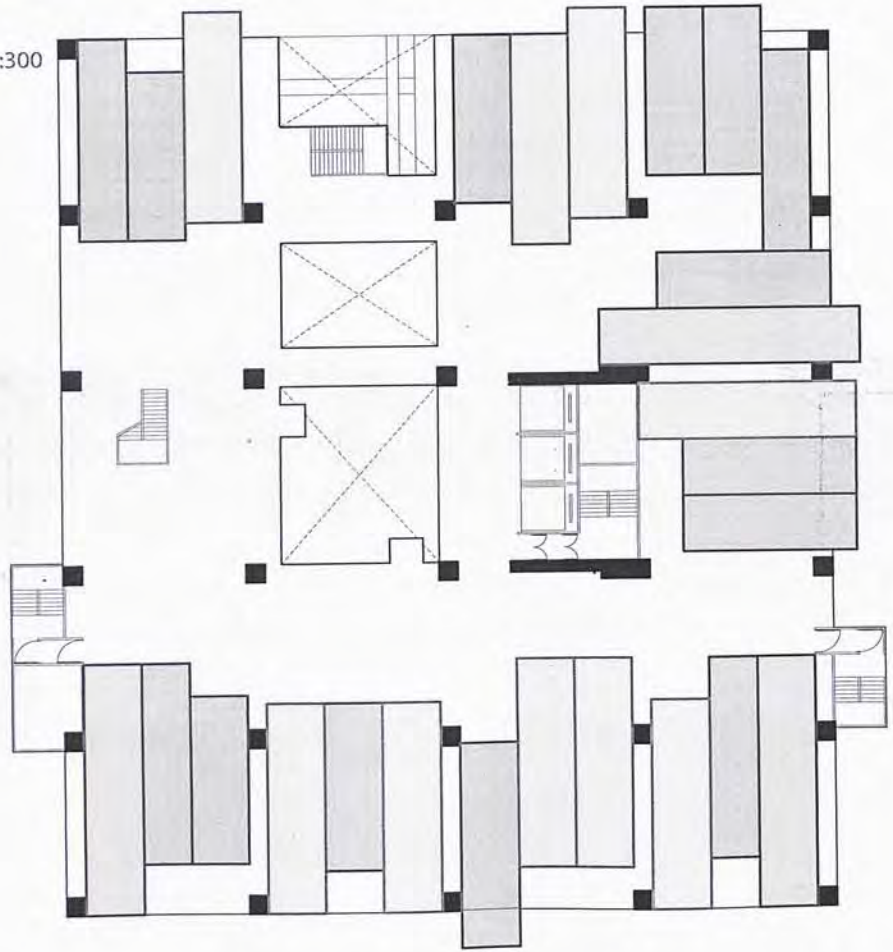
Section C



Grouping every 4 floors
Unit size same as
Scheme 1
Typical Floor Plan 1:300

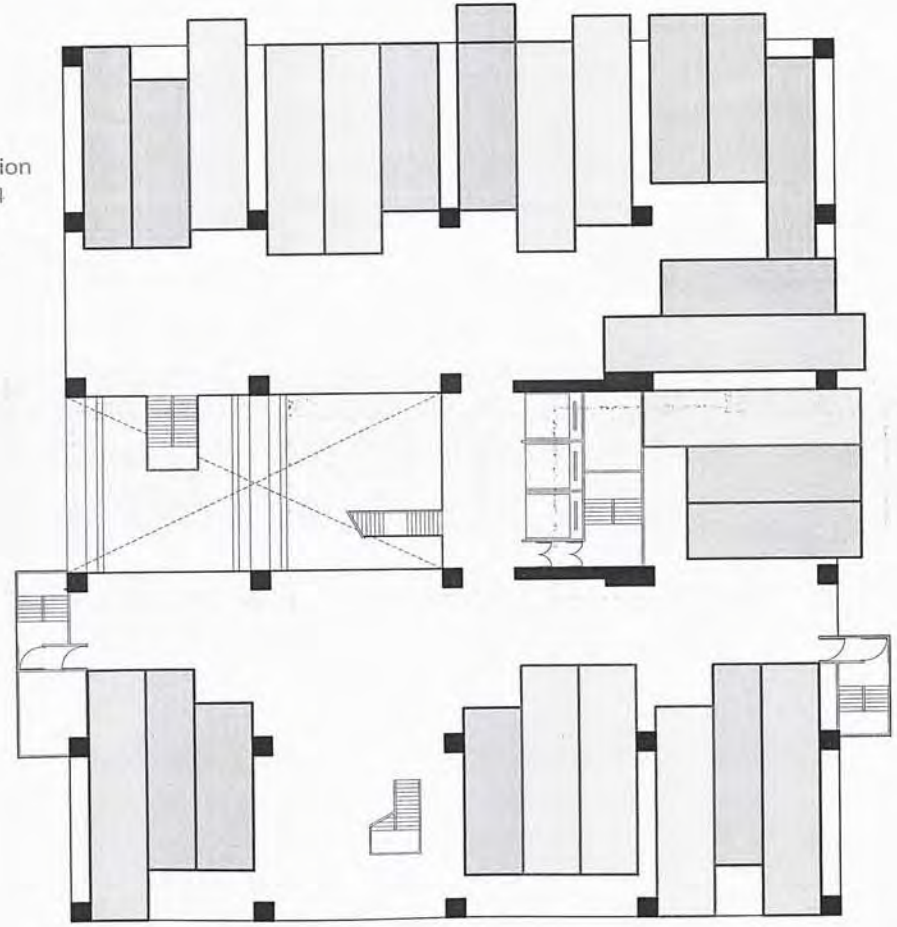
LEVEL 1

Units distribution
1-bedroom 14
2-bedroom 9
3-bedroom 3



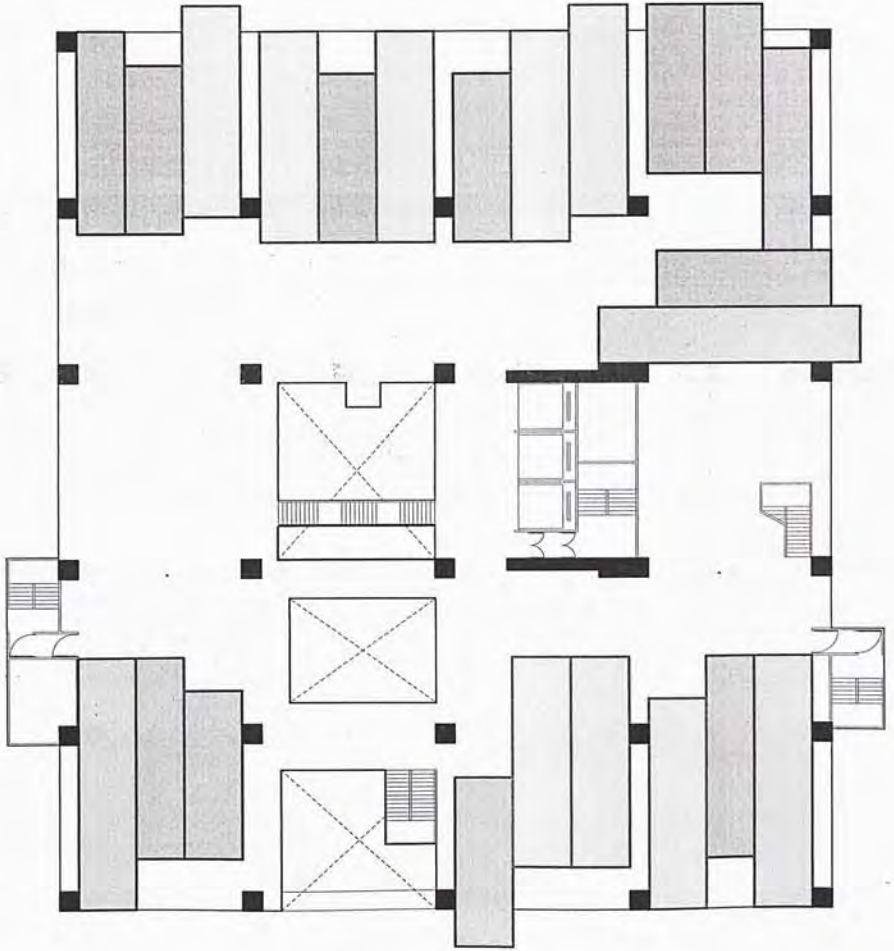
LEVEL 2

Units distribution
1-bedroom 14
2-bedroom 9
3-bedroom 3



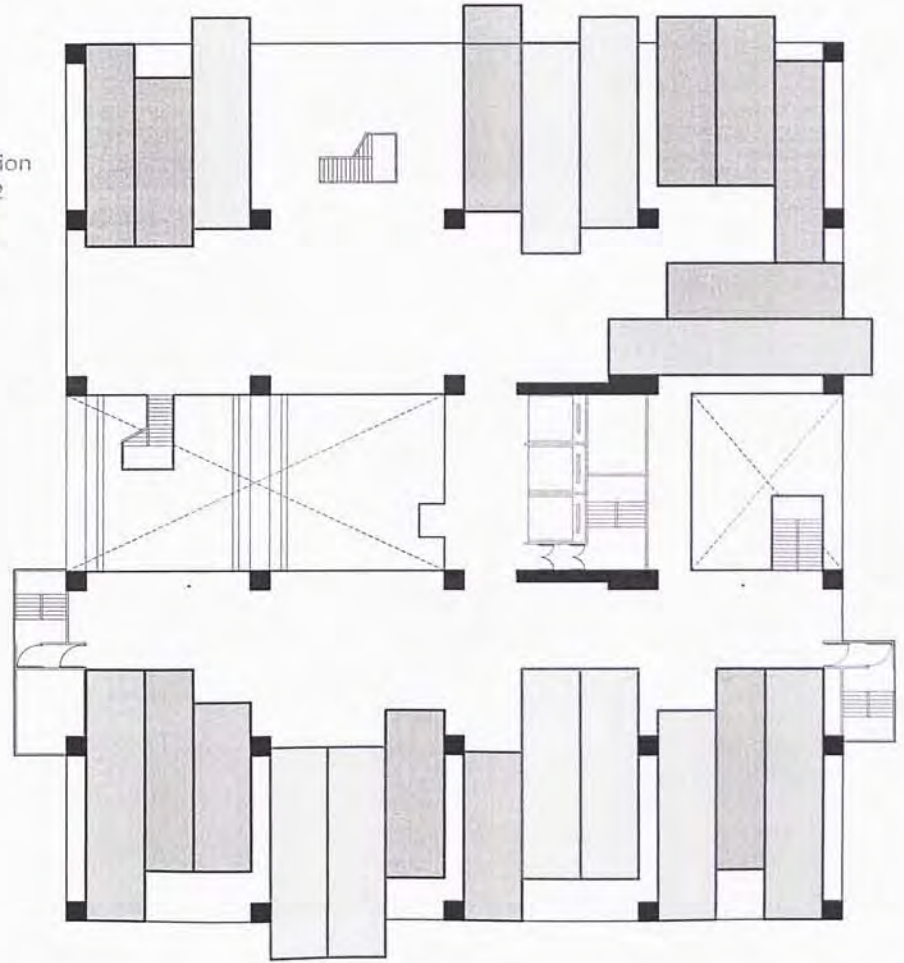
LEVEL 3

Units distribution
1-bedroom 12
2-bedroom 8
3-bedroom 3

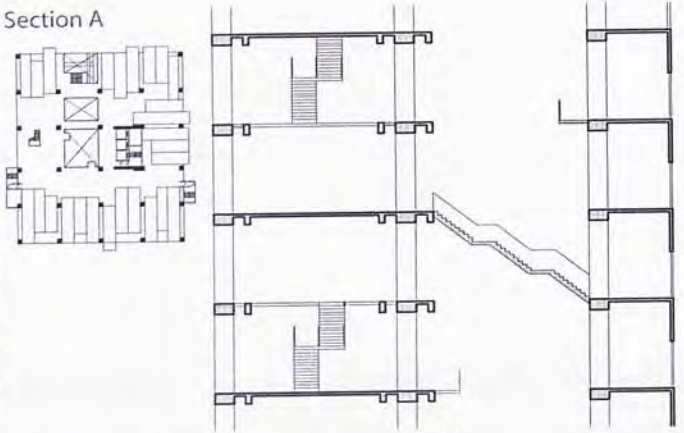


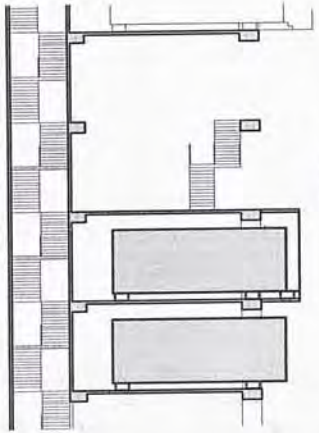
LEVEL 4

Units distribution
1-bedroom 12
2-bedroom 8
3-bedroom 3

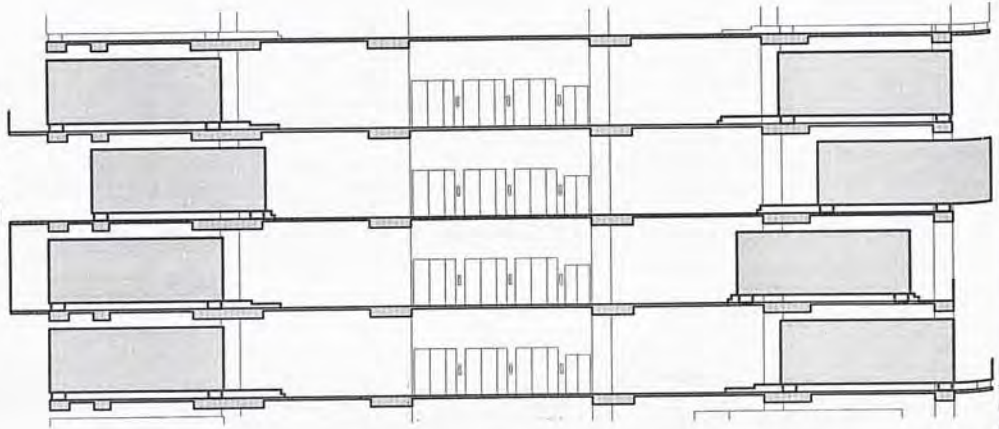


Section A

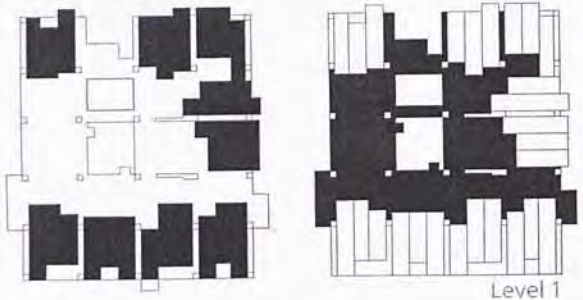




Section B

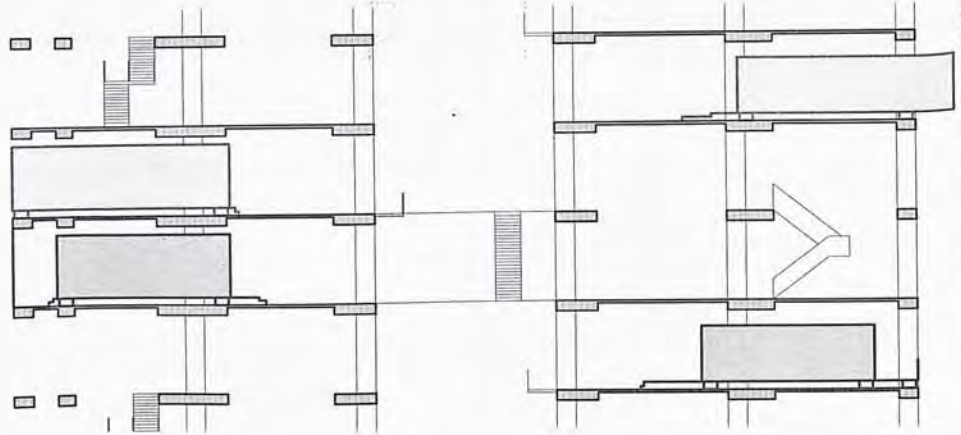


Relationship of
Unit and Open Space



Level 1

Section C



Grouping every 3 floors
Unit size based on
module 3x9m
Typical Floor Plan 1:300

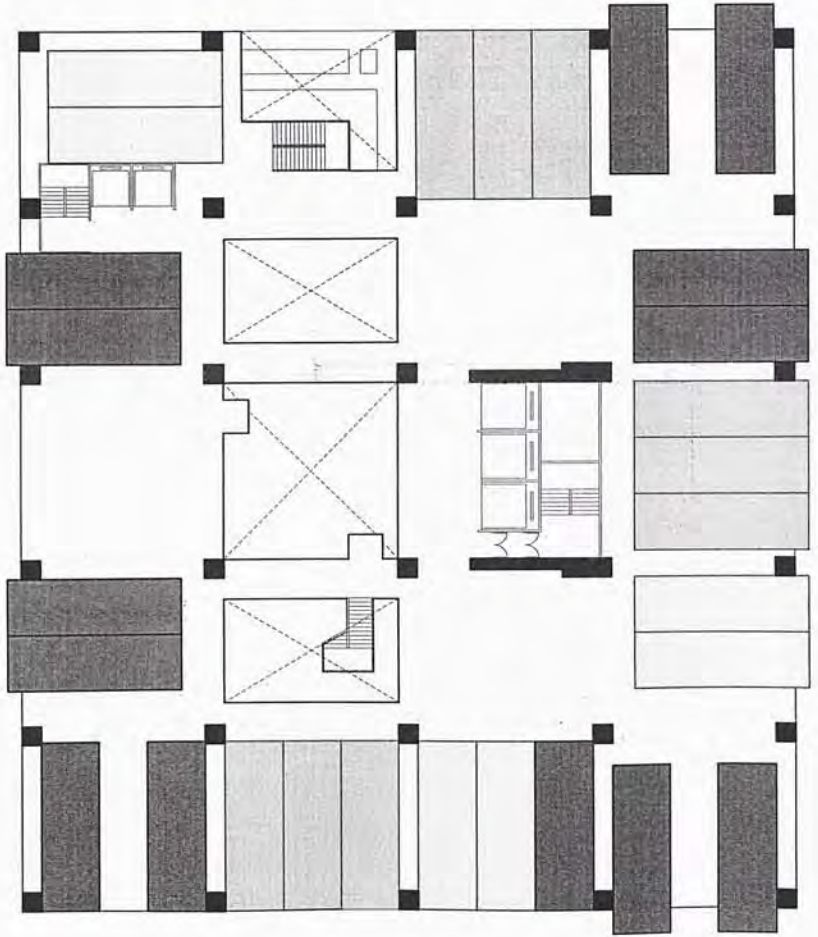
LEVEL 1
U-SHAPE

Units distribution
1-bedroom 10
2-bedroom 6
3-bedroom 3

RATIO
3.33 : 2 : 1

MODULE 3 x 9m

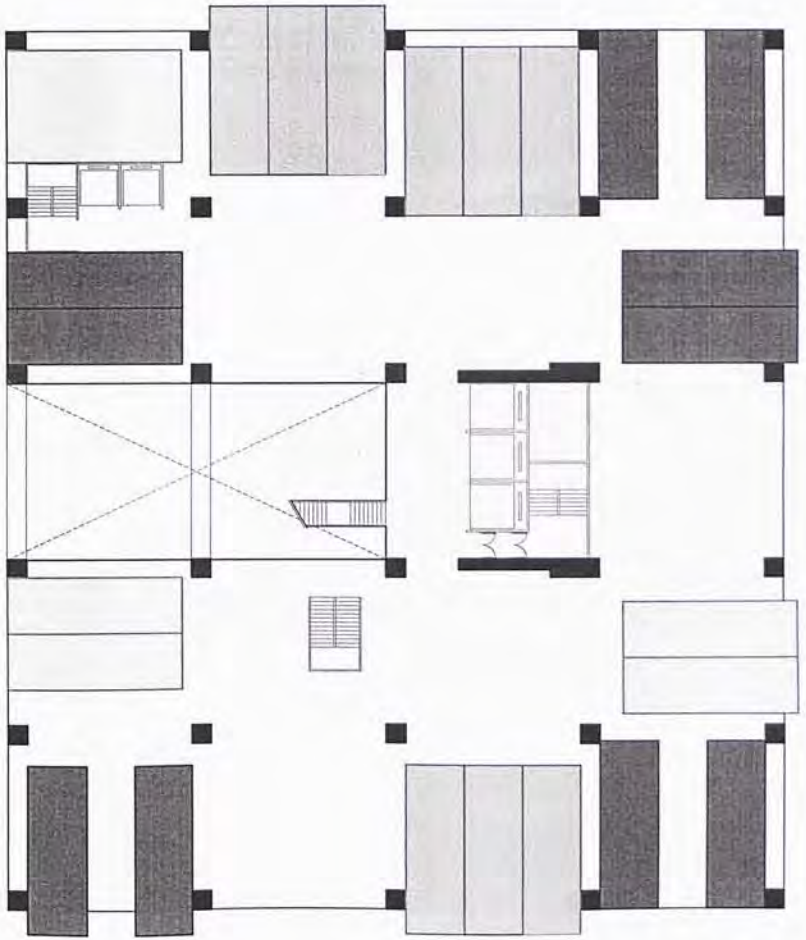
1-bedroom
= 1 module
2-bedroom
= 1.5 module
3-bedroom
= 2 module



LEVEL 2
C-SHAPE

Units distribution
1-bedroom 13
2-bedroom 6
3-bedroom 3

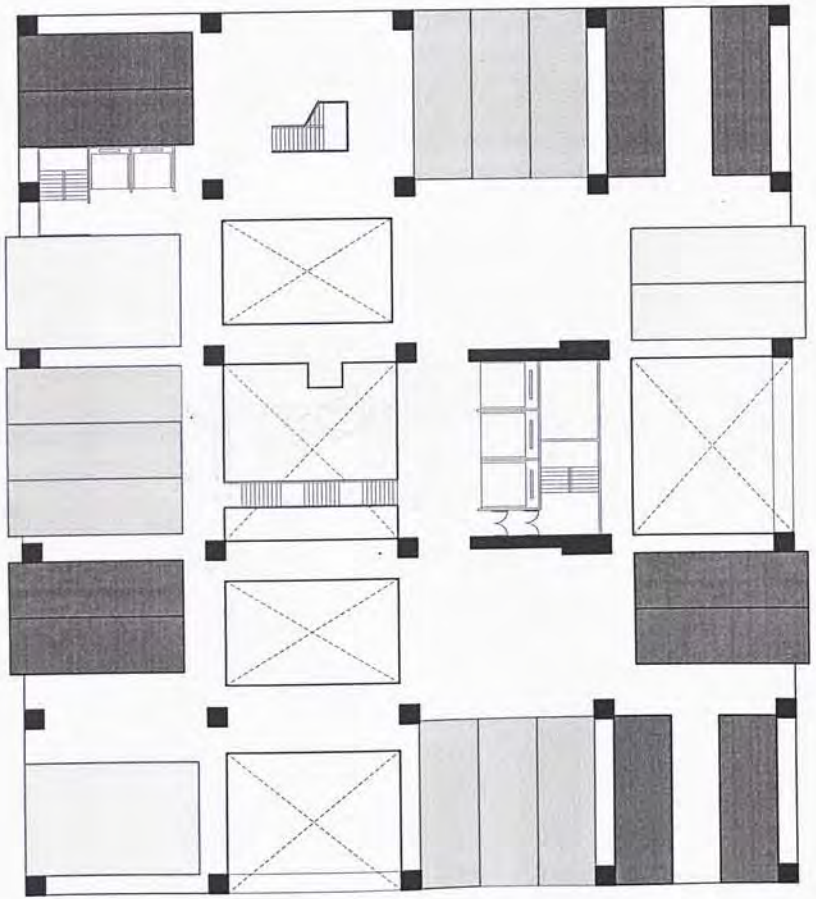
RATIO
4.33 : 2 : 1

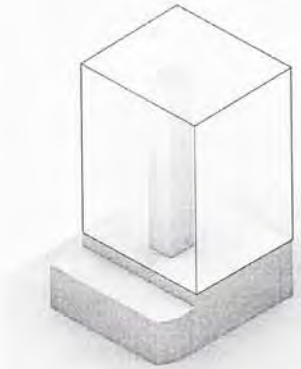


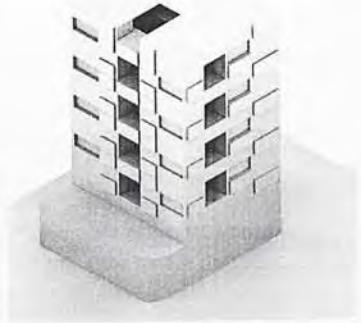
LEVEL 3
N-SHAPE

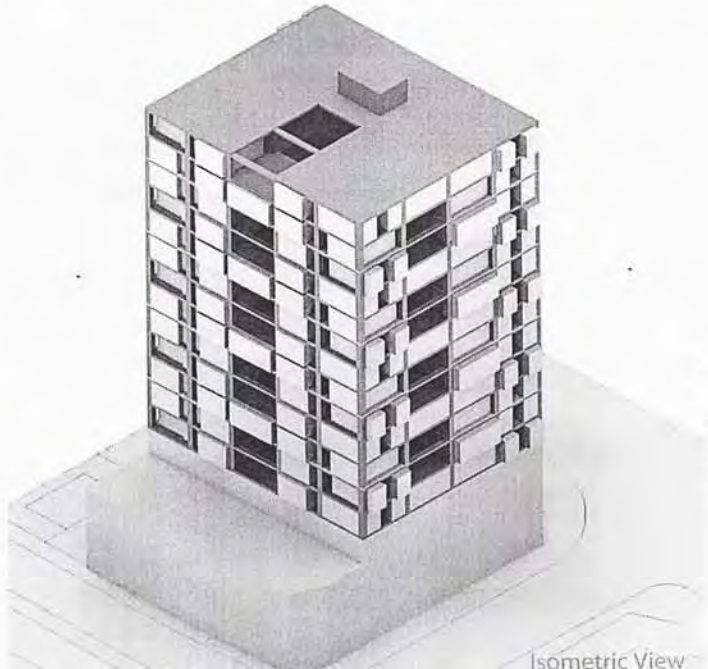
Units distribution
1-bedroom 10
2-bedroom 6
3-bedroom 3

RATIO
3.33 : 2 : 1

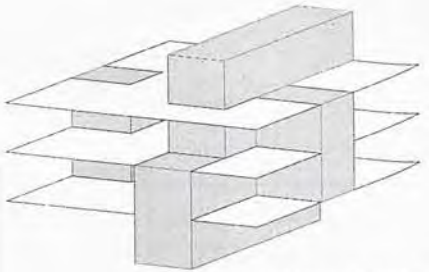






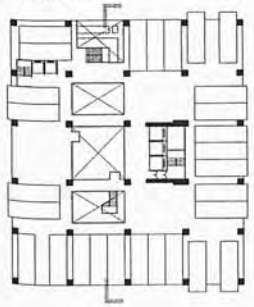


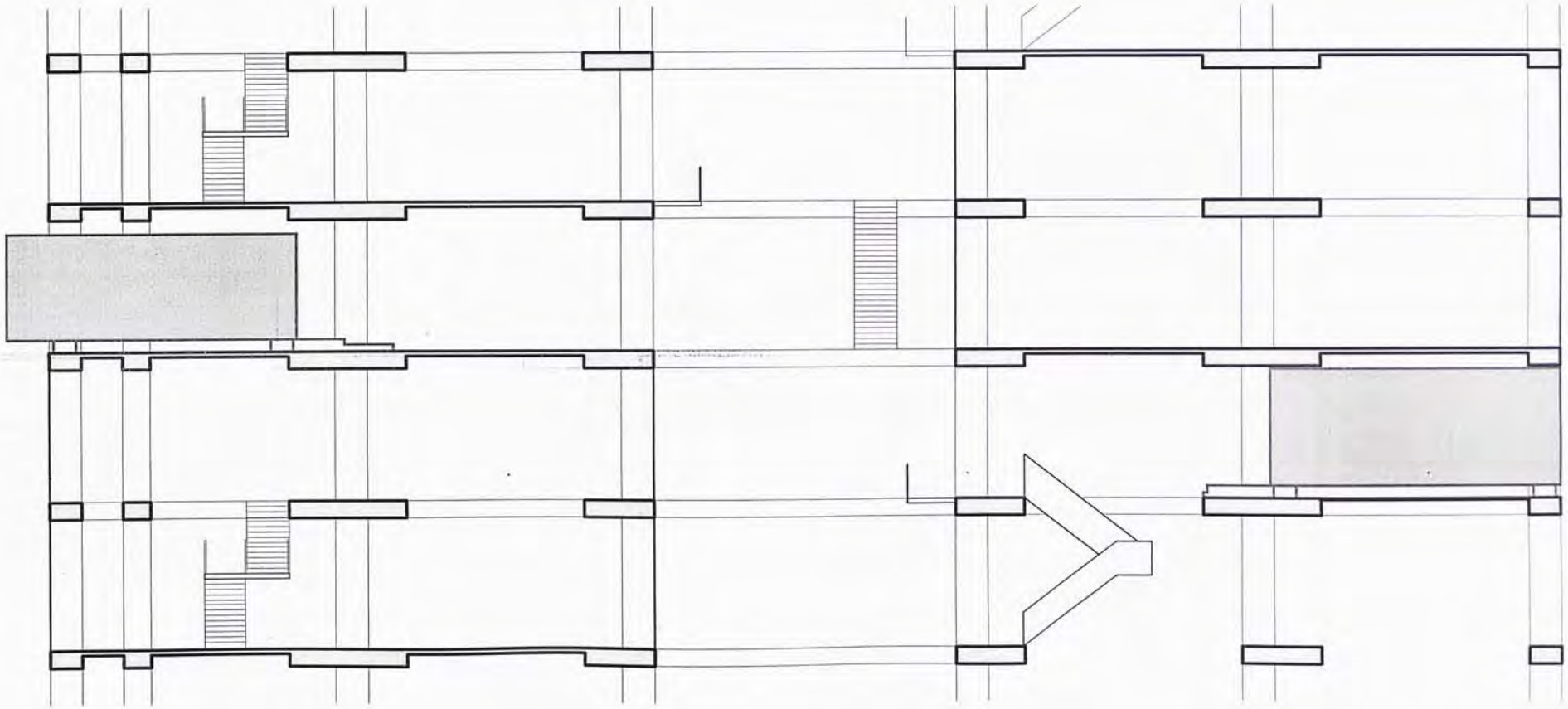
Isometric View



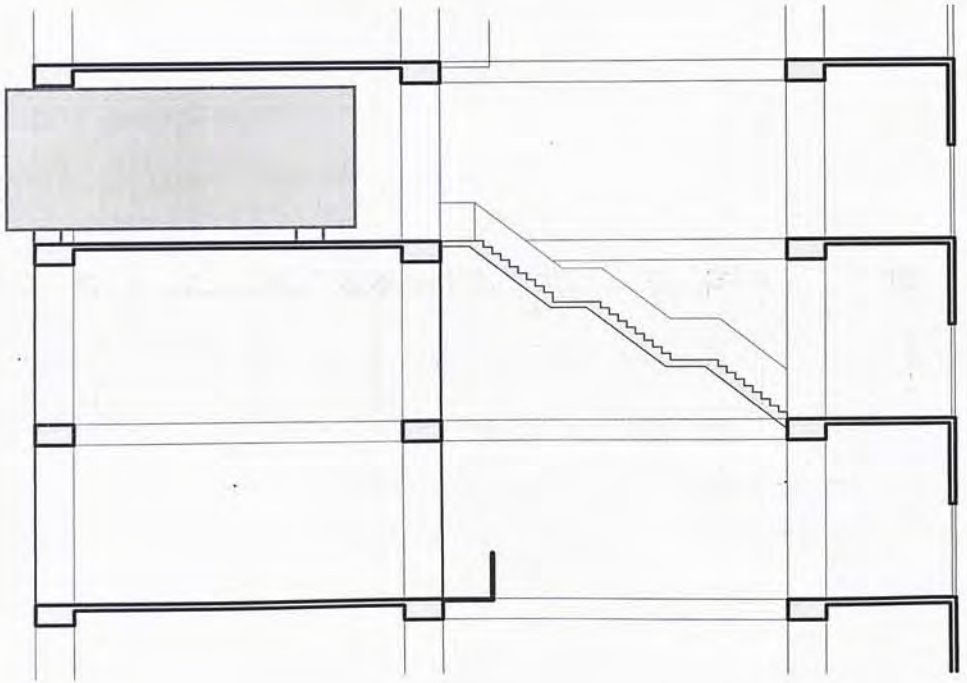
Series of Open Space

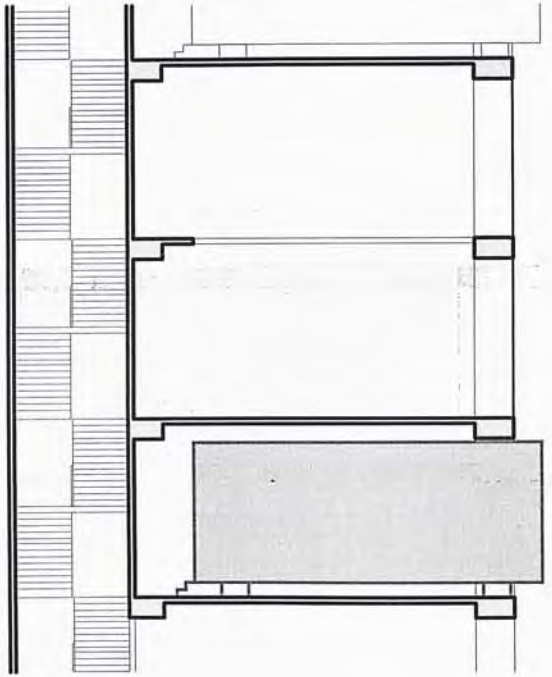
Section A 1:150





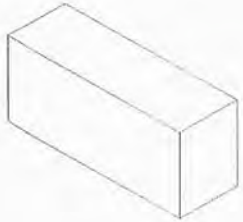
Section B 1:150





.5 Unit design

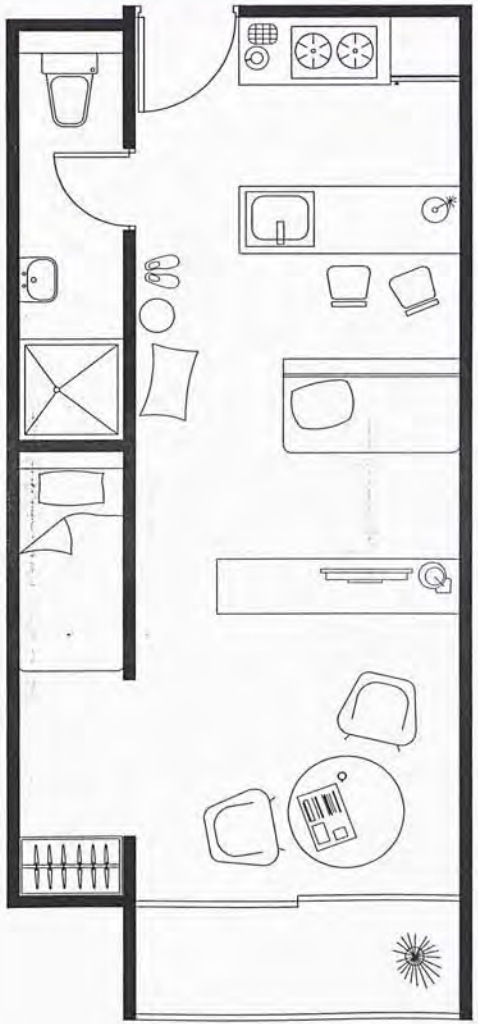
1 module



1-BEDROOM UNIT : 140 m^3
1 PERSON

1 single bedroom
1 bathroom
1 open kitchen

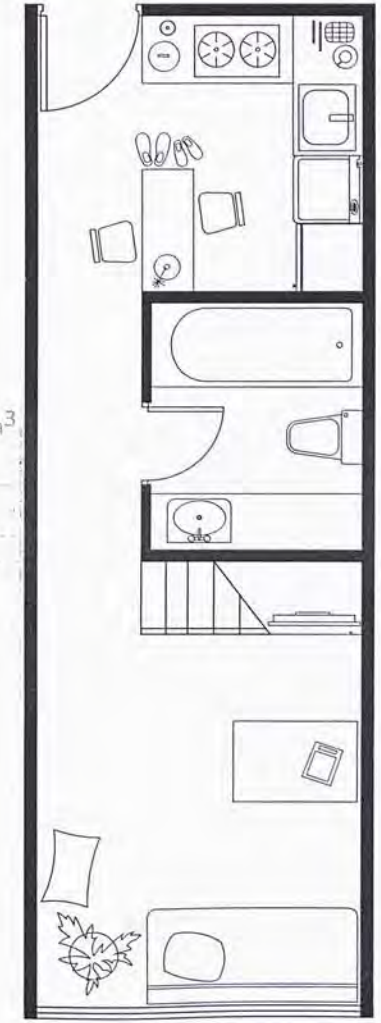
1 balcony

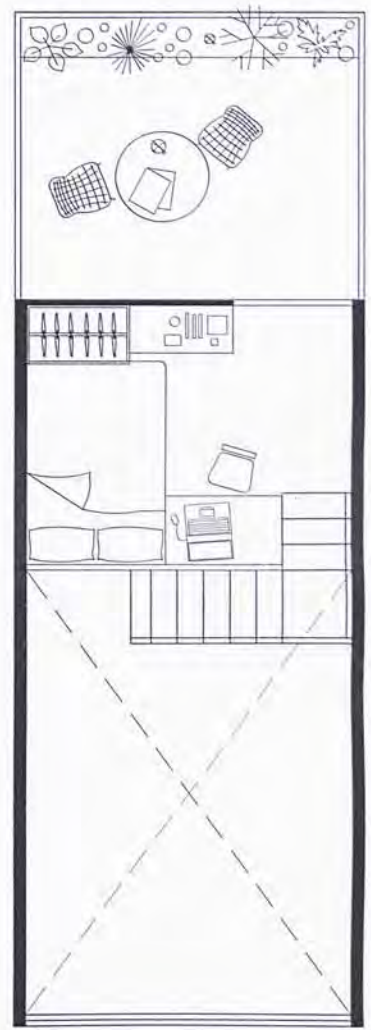


1-BEDROOM UNIT : 108 m^3
1 COUPLE

1 double bedroom
1 bathroom
1 open kitchen

1 upper floor balcony



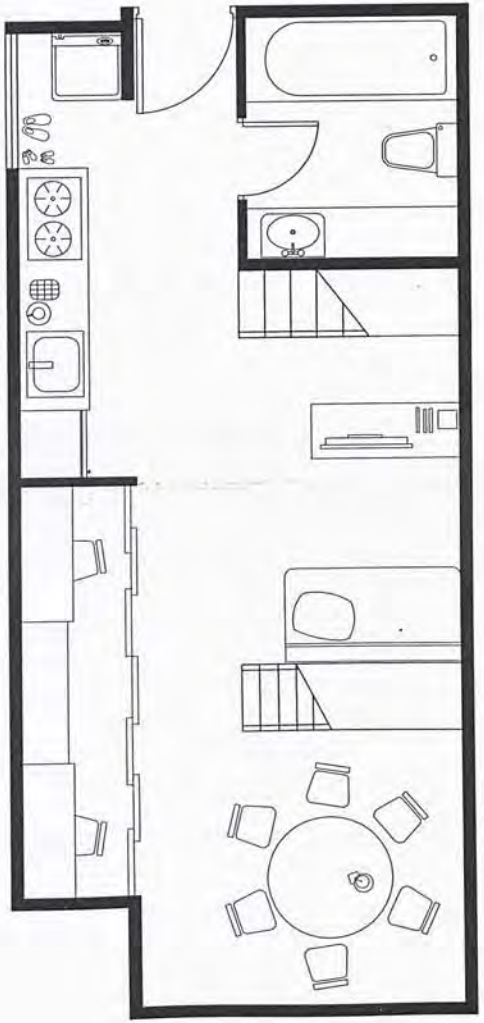


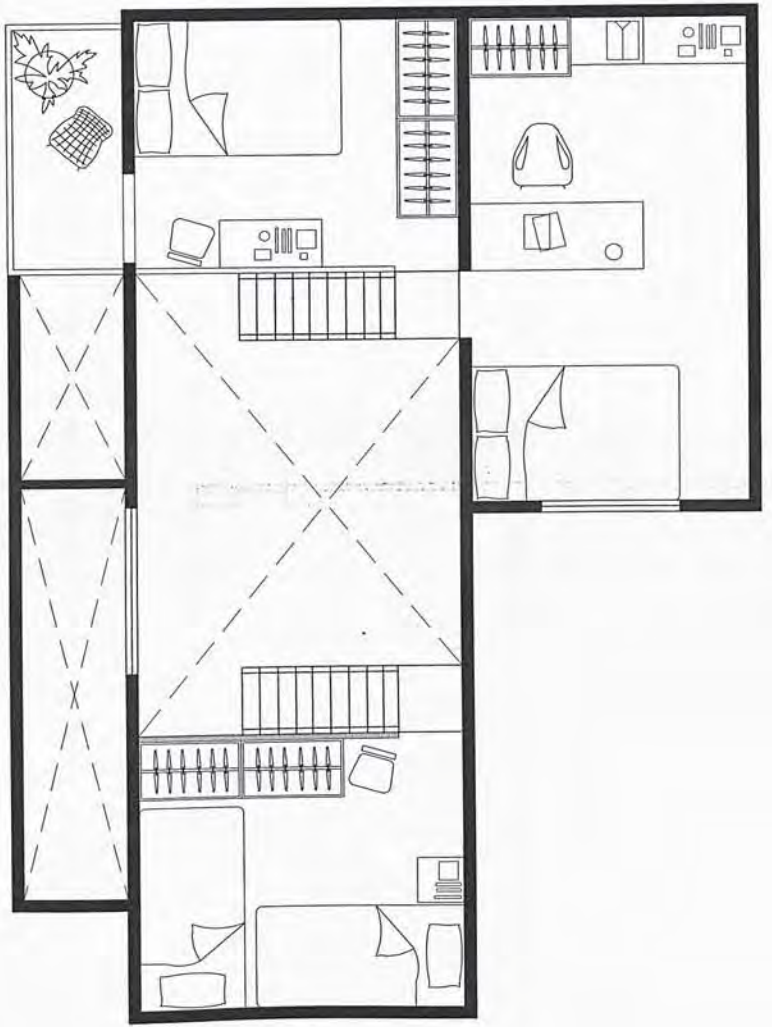
1 module

1-BEDROOM UNIT : 184 m^3
6 PERSON
- 2 gradparents
- 2 patents
- 2 children

1 single bedroom
2 double bedroom
1 bathroom
1 open kitchen
1 study room

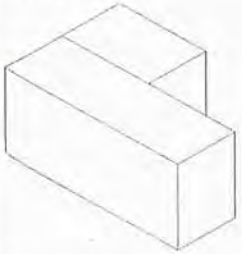
1 upper floor balcony





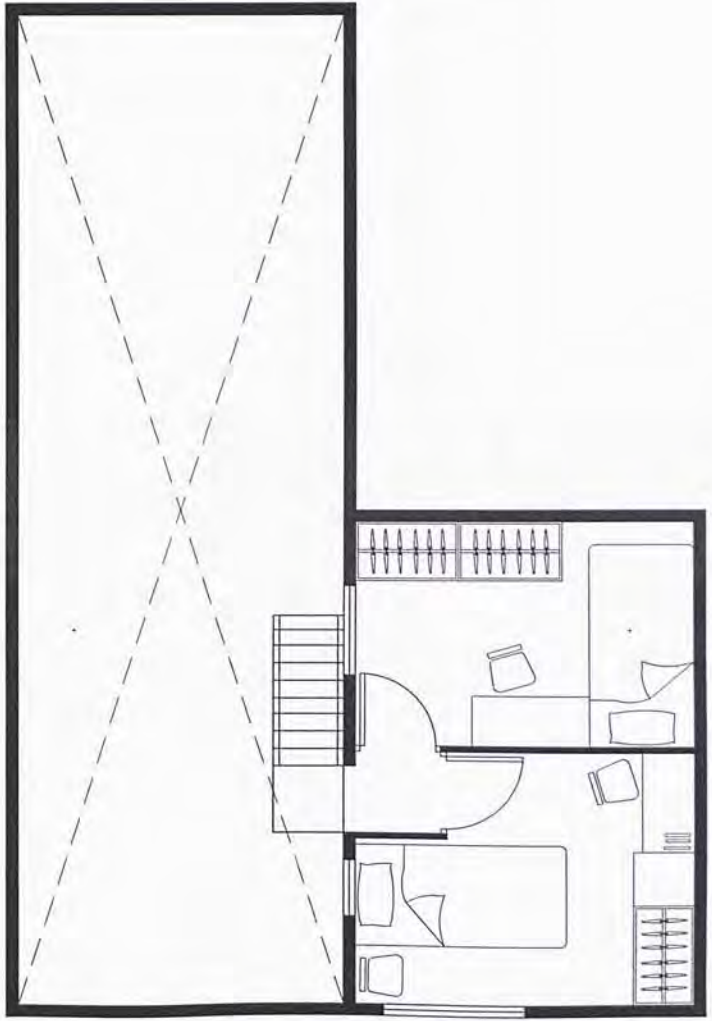
.5 Unit design

1.5 module

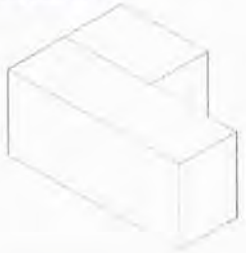


2-BEDROOM UNIT : 164 m^3
5 PERSON
- 1 grandparent
- 2 parents
- 2 children

3 single bedroom
1 double bedroom
1 bathroom
1 kitchen

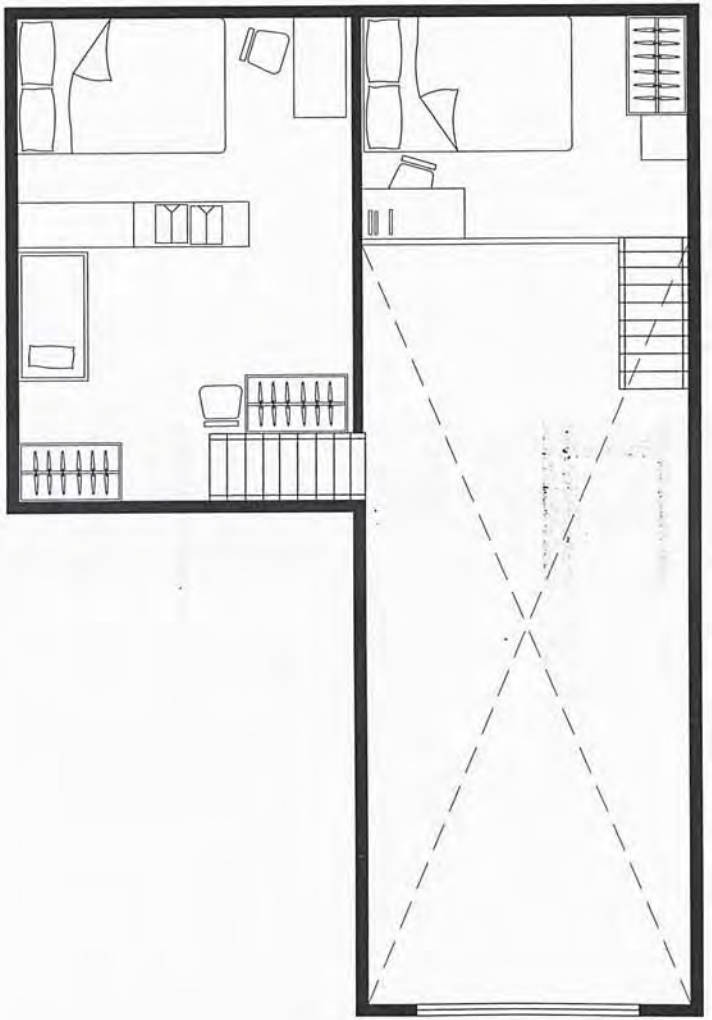


1.5 module



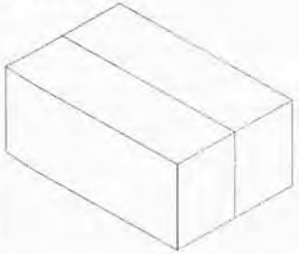
2-BEDROOM UNIT : 164 m^3
5.5 PERSON
- 2 grandparents
- 2 parents
- 1 child
- 1 baby

1 single bedroom
2 double bedroom
1 bathroom
1 kitchen



.5 Unit design

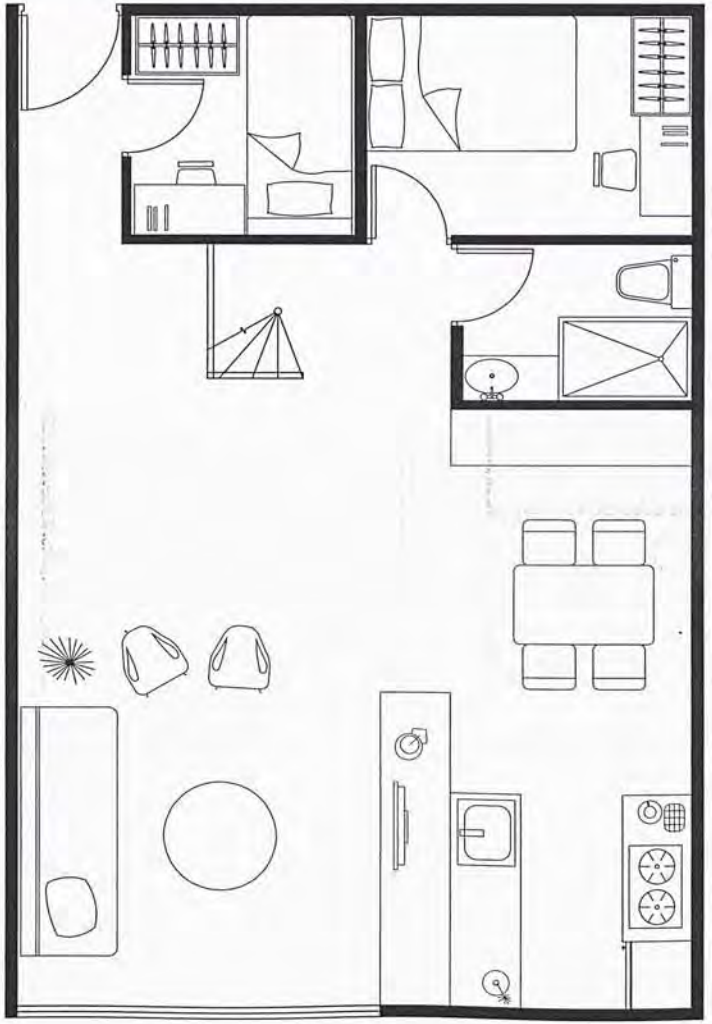
2 module

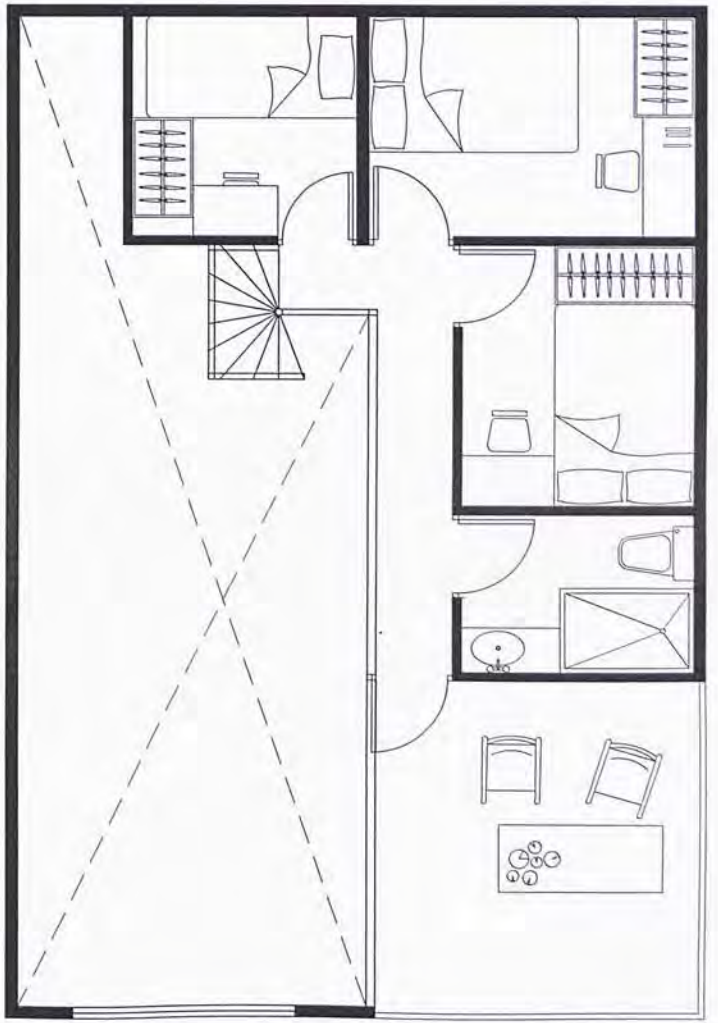


3-BEDROOM UNIT : 216 m^3
8 PERSON
- 2 gradnparents
- 2 parents
- 1 couple
- 2 children

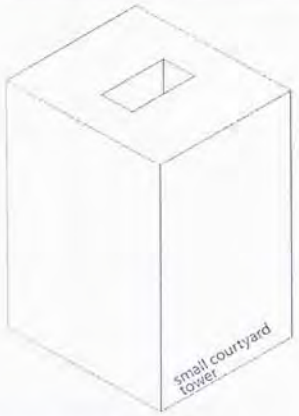
2 single bedroom
3 double bedroom
2 bathroom
1 open kitchen

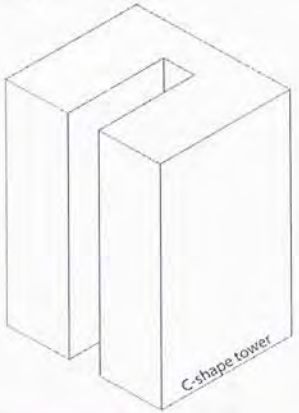
1 upper floor balcony

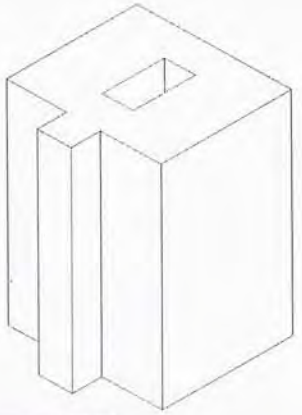


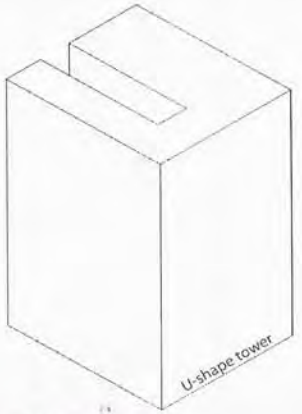


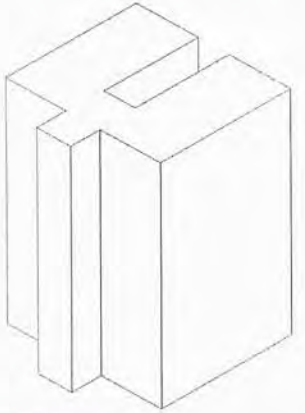
9.0 Mass study form - layout - no of units

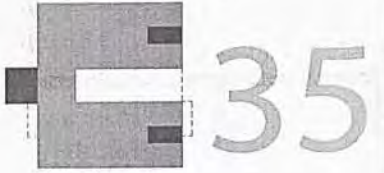


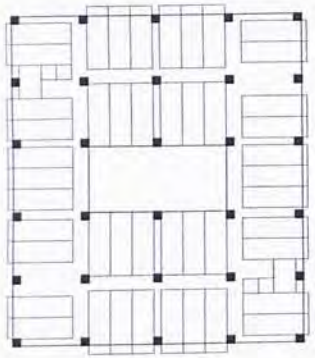


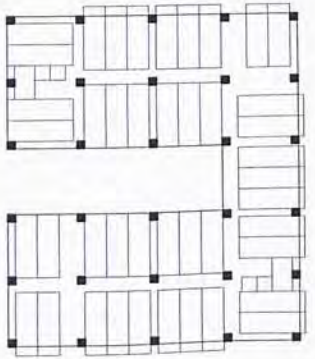


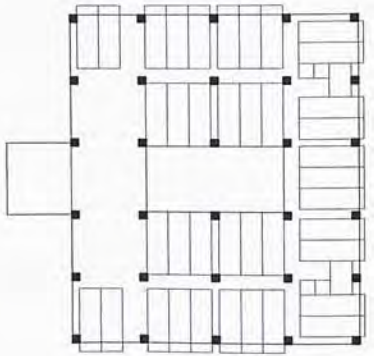


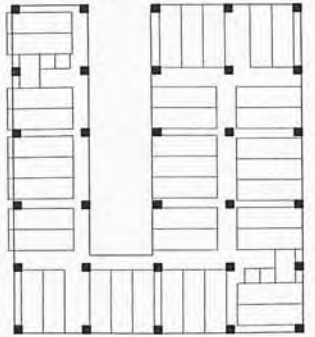


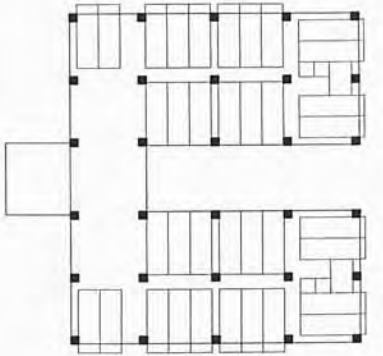


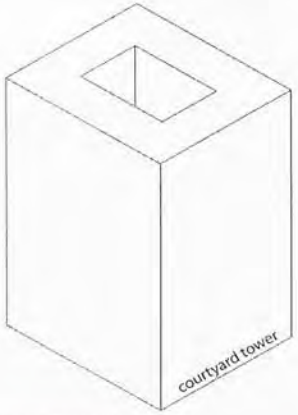


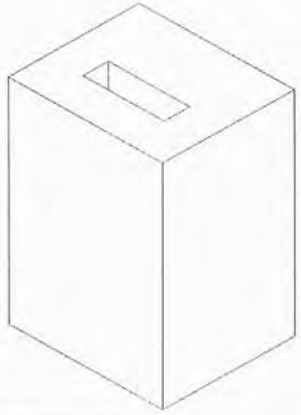


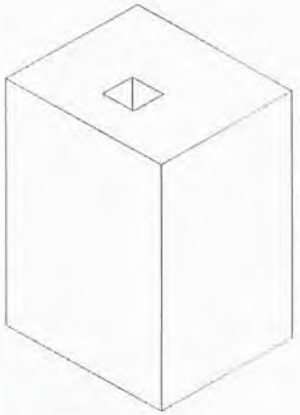


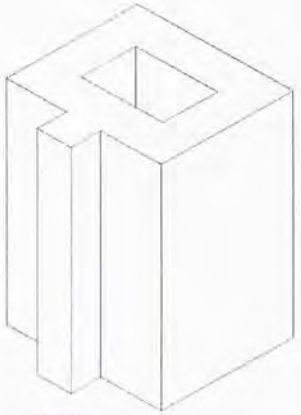


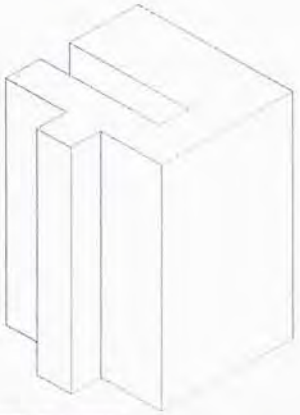



courtyard tower







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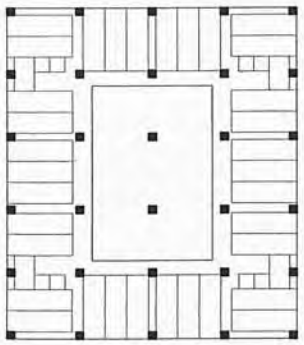
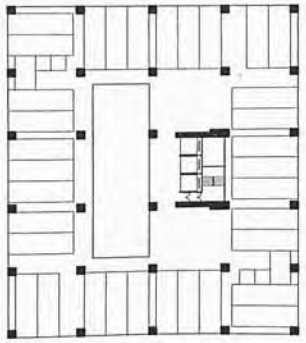
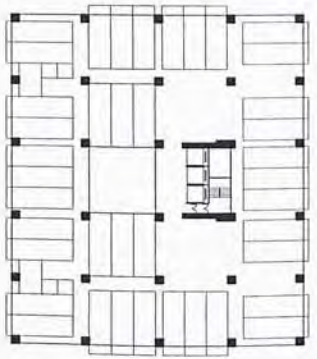
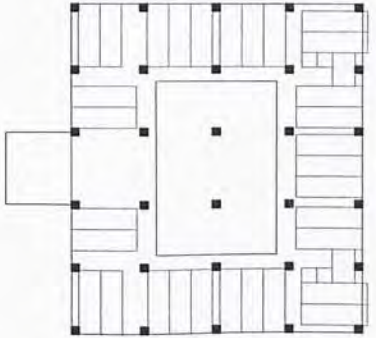
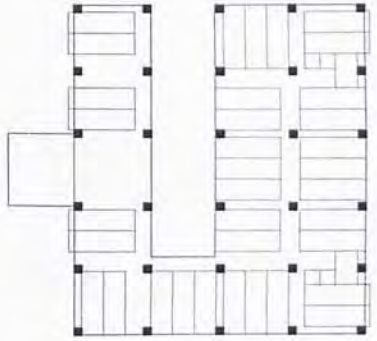










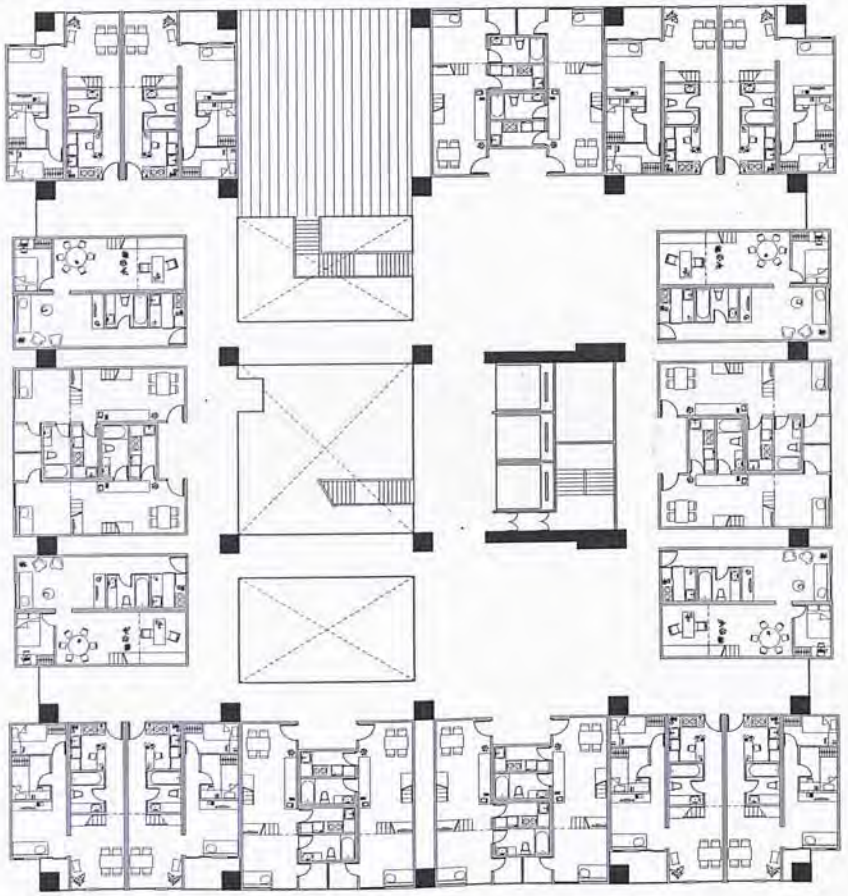
10.1 Design Proposal LAYOUT PLAN

Grouping every 3 floors
Unit size based on 3 modules
Typical Floor Plan 1:300

LEVEL 1
U-SHAPE

Units distribution
1-bedroom 10
2-bedroom 8
3-bedroom 4

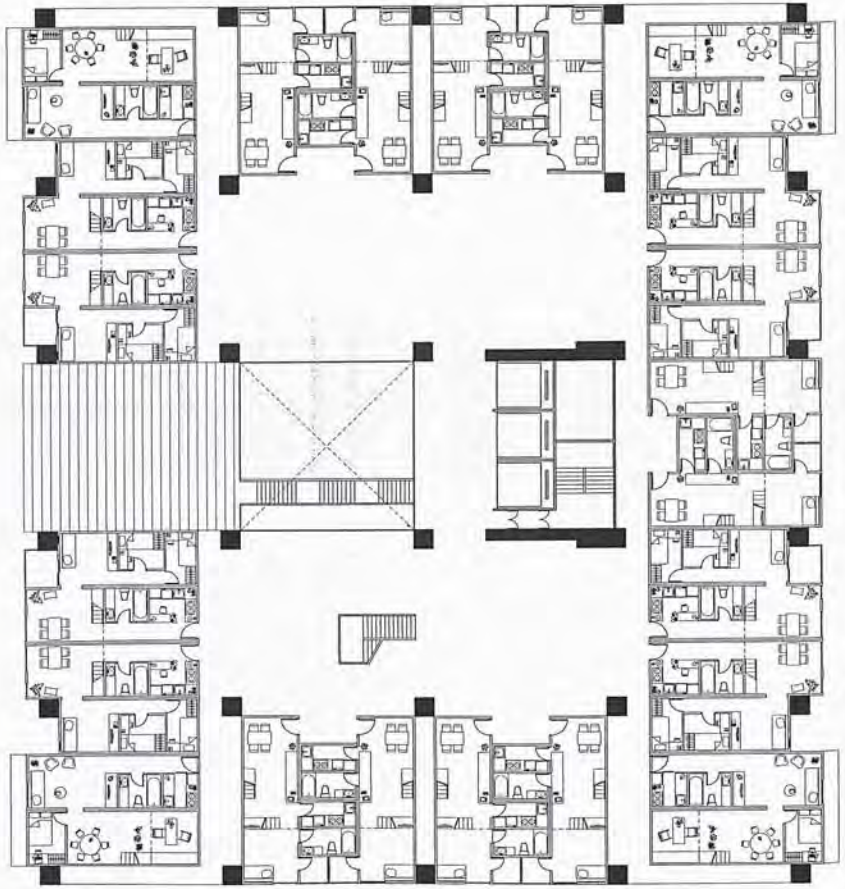
RATIO
2.5 : 2 : 1



LEVEL 2
C-SHAPE

Units distribution
1-bedroom 10
2-bedroom 8
3-bedroom 4

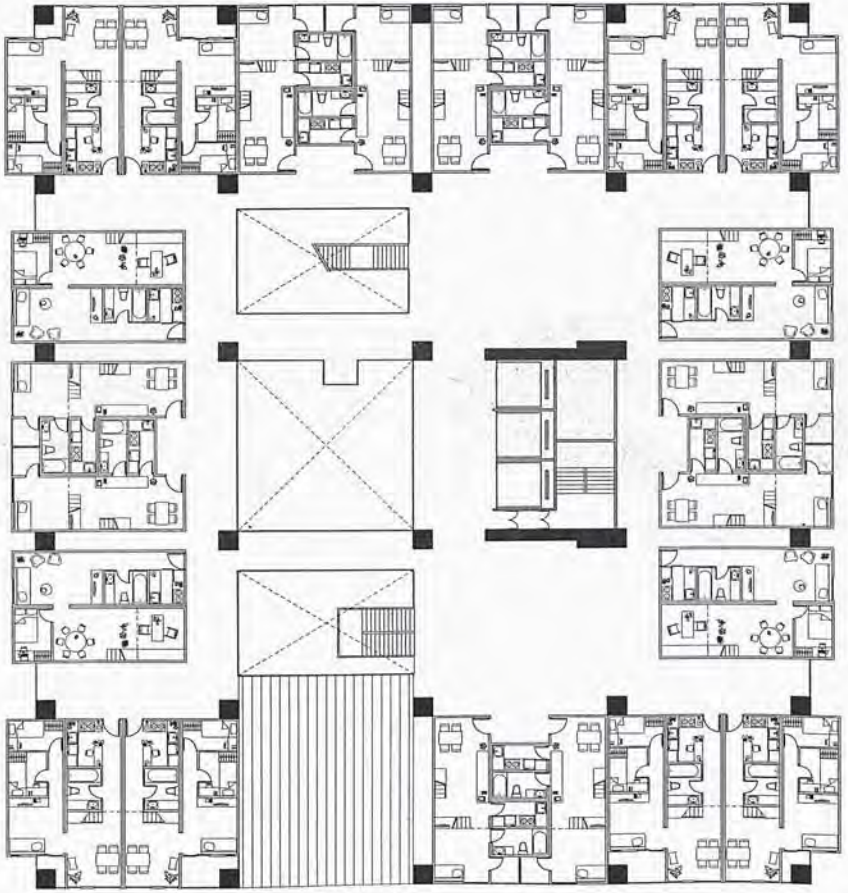
RATIO
2.5 : 2 : 1



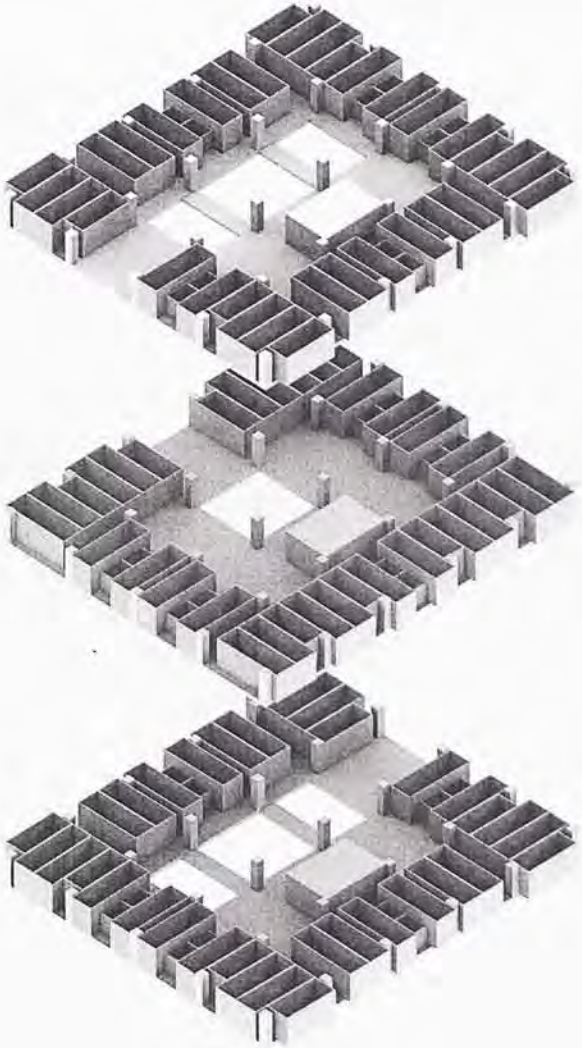
LEVEL 3
N-SHAPE

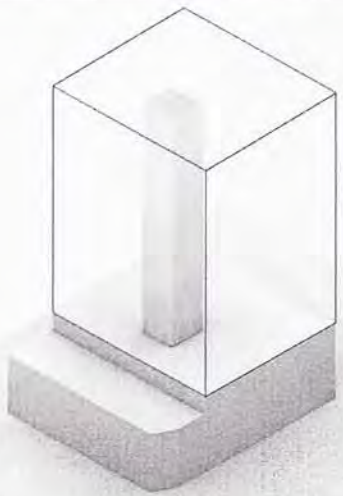
Units distribution
1-bedroom 10
2-bedroom 8
3-bedroom 4

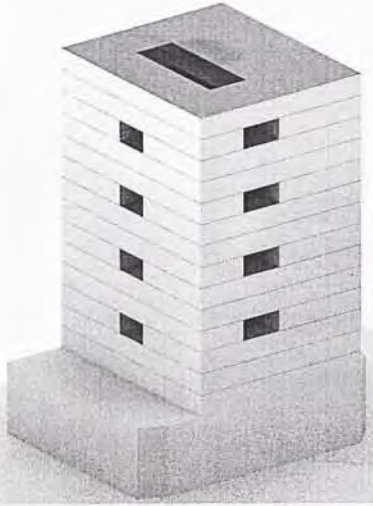
RATIO
2.5 : 2 . 1

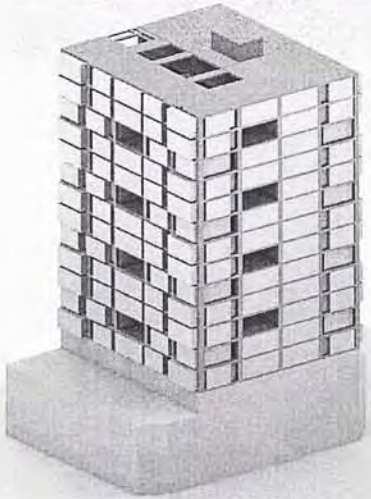


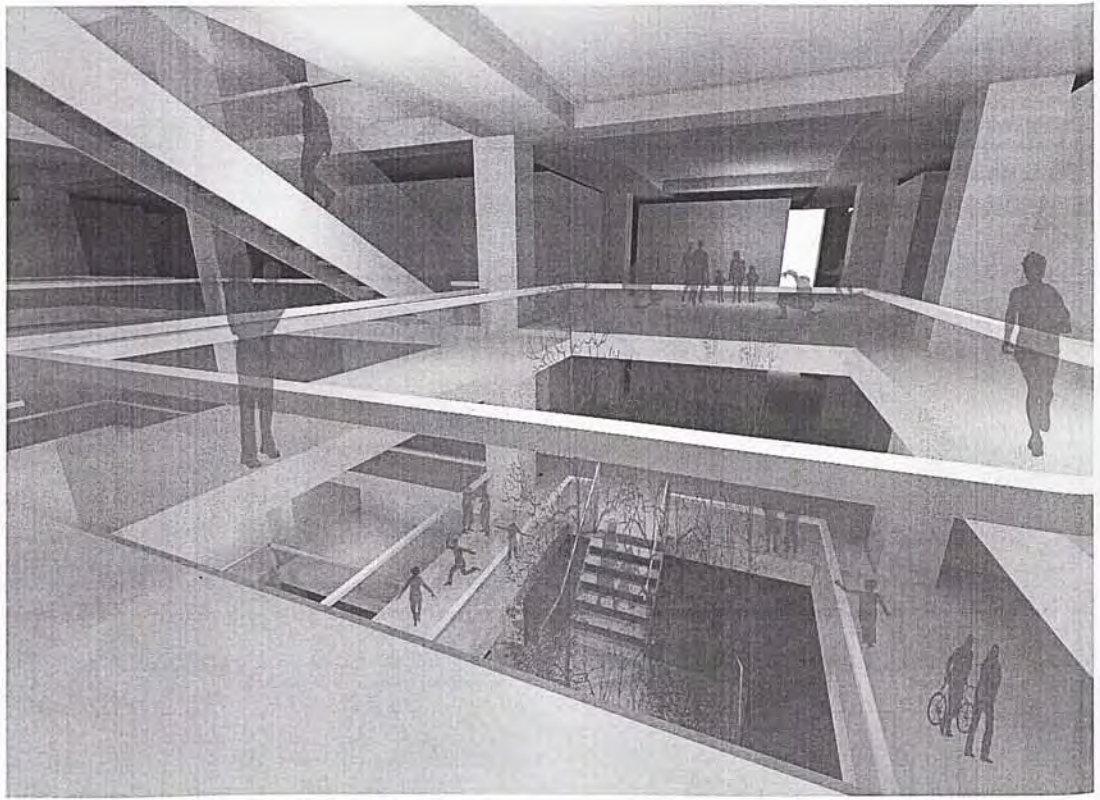
Isometric diagram showing open space on each floor



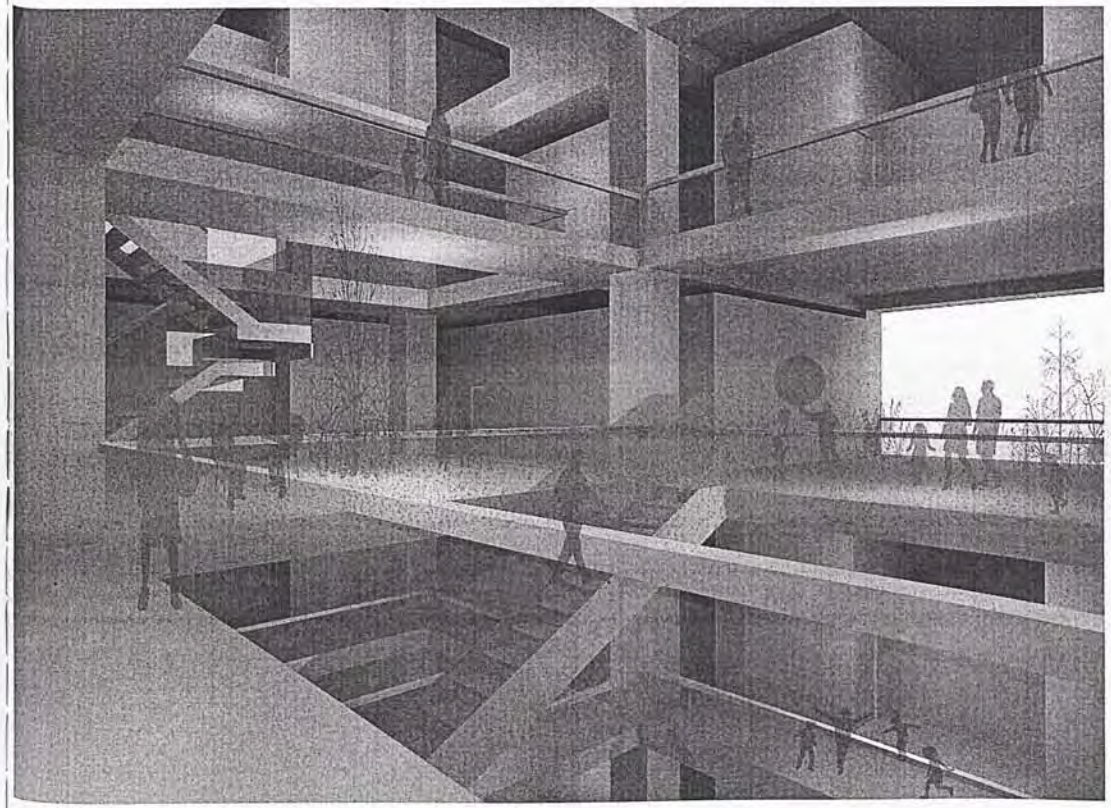




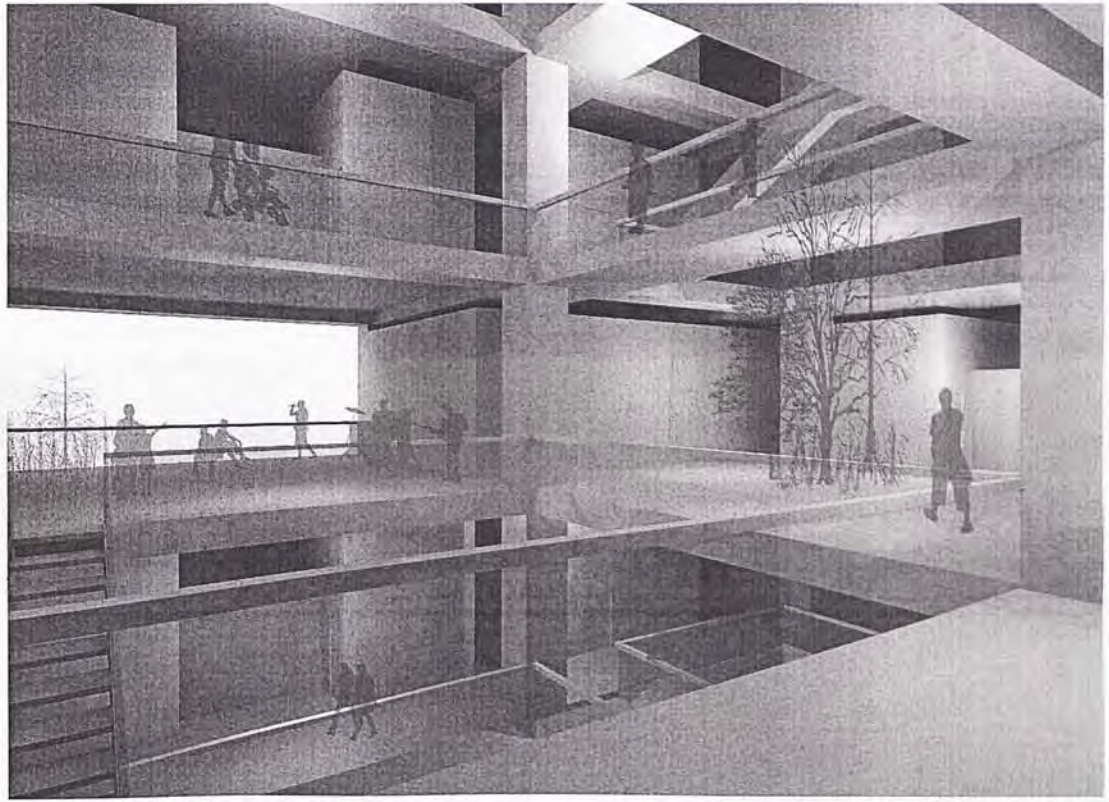




Perspective view showing internal courtyard

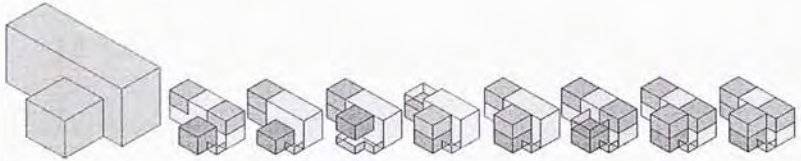


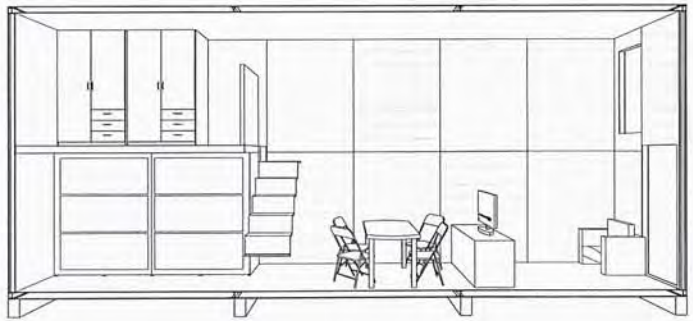
Perspective view showing central courtyard

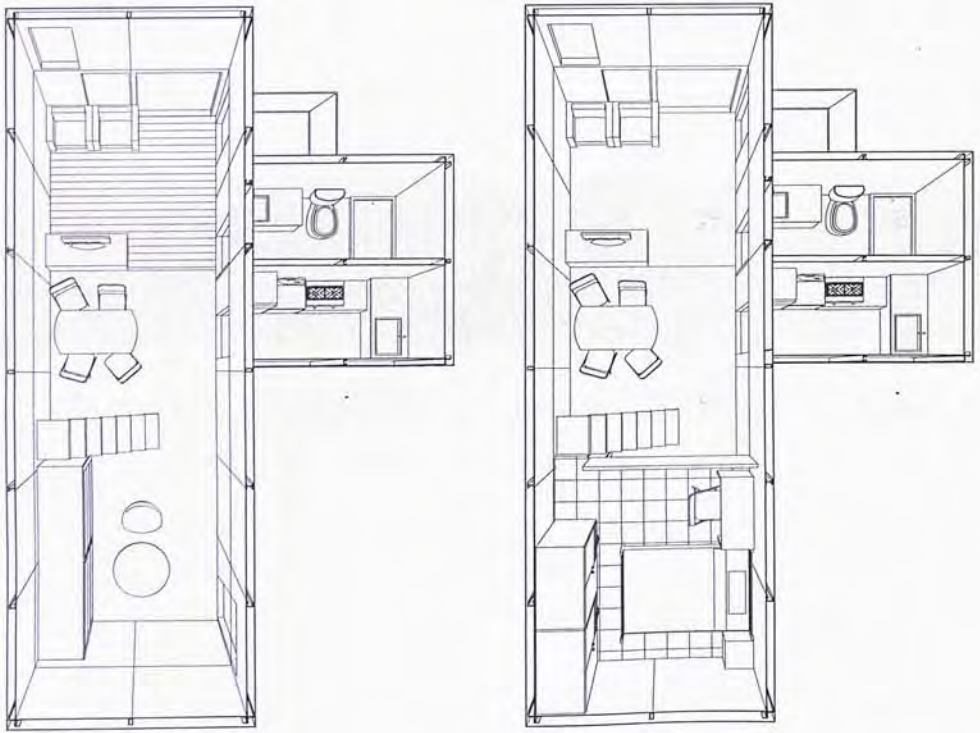


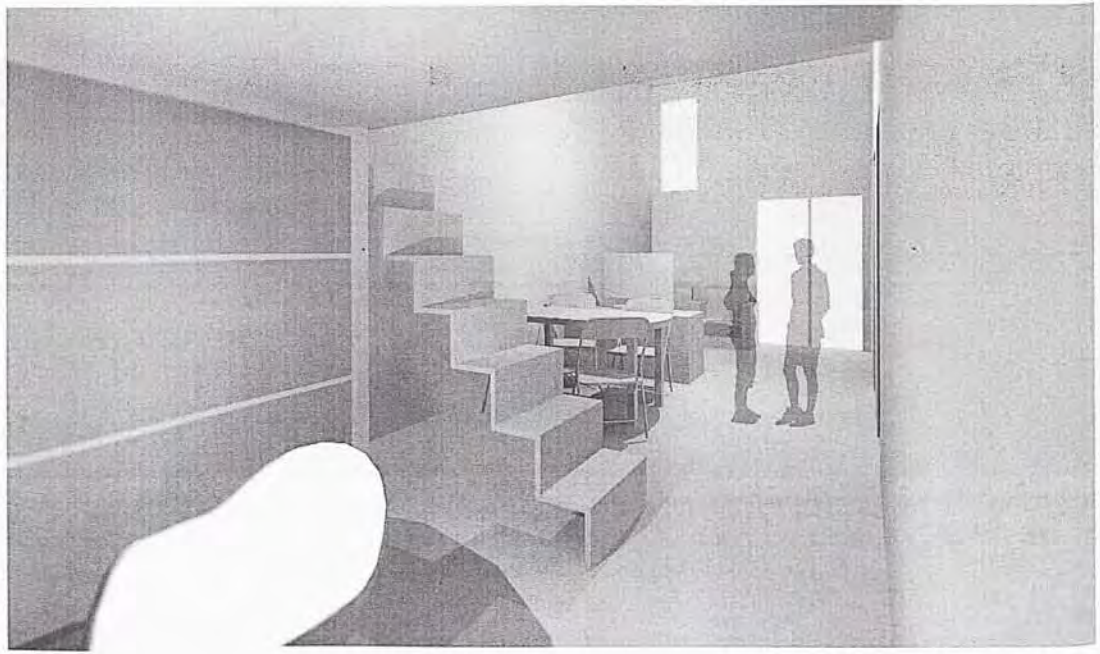
Perspective view showing central courtyard

Type A : 36m2



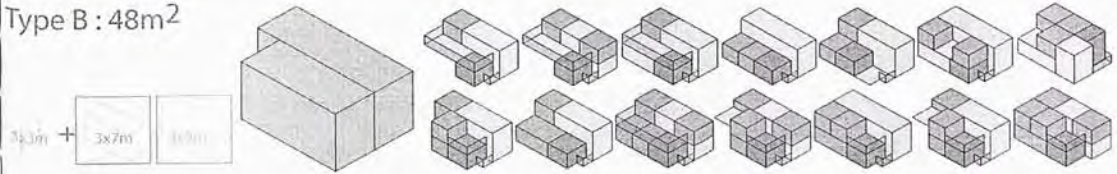


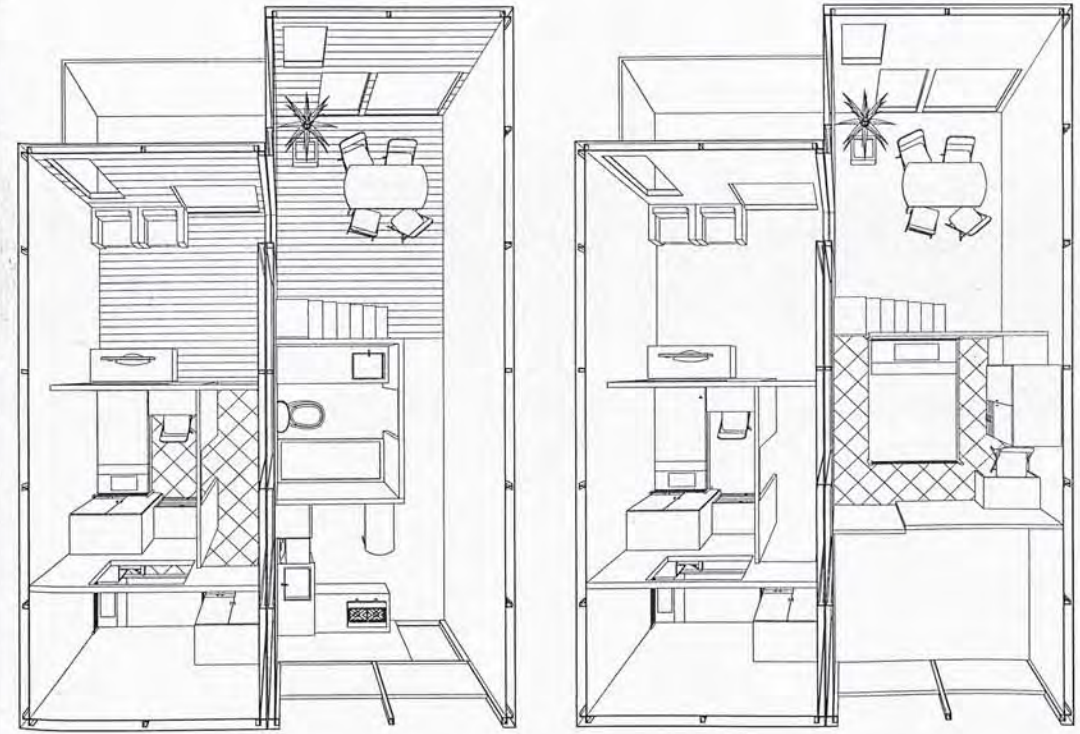




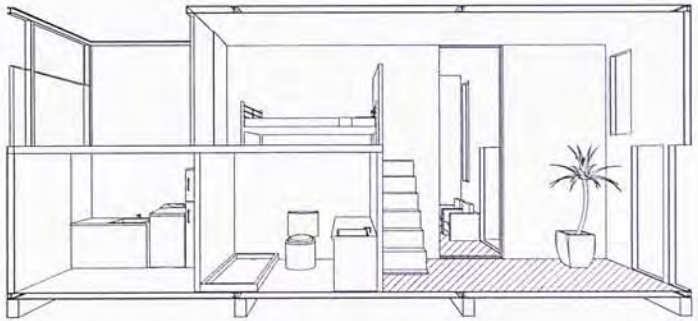
Plan, Section 1:100

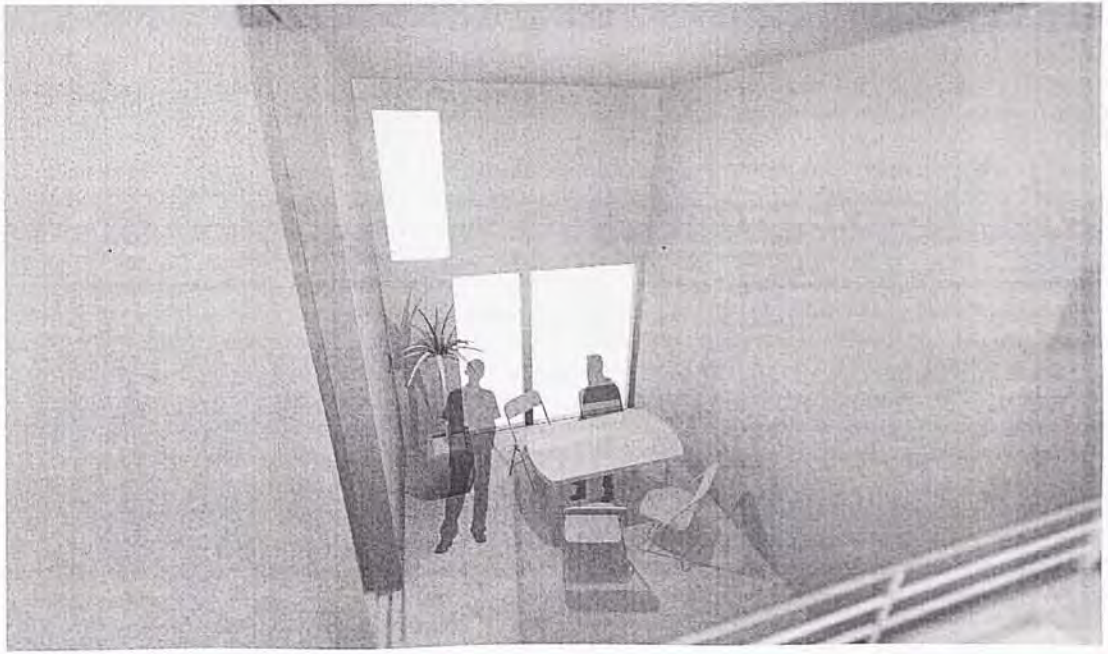
Type B : 48m2



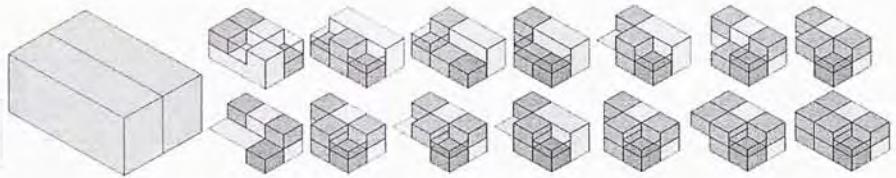


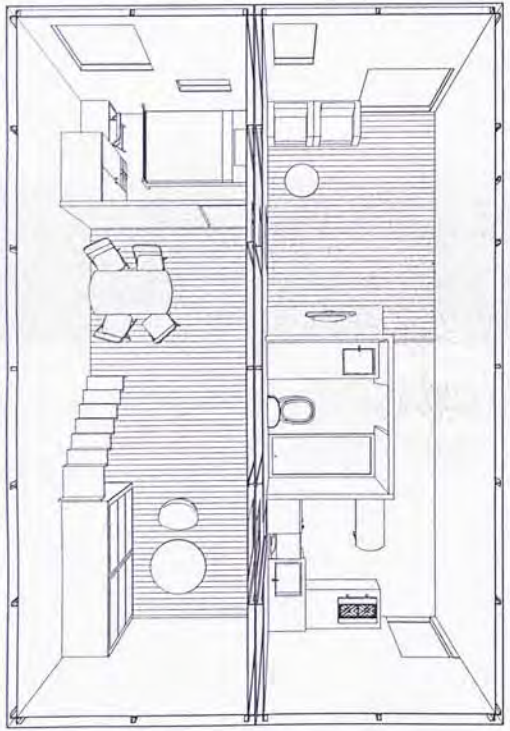
Plan, Section 1:100

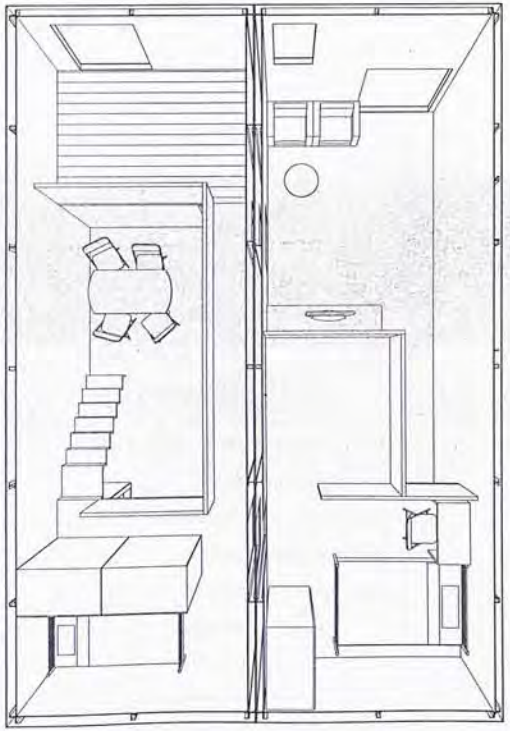




Type C : 54m^2







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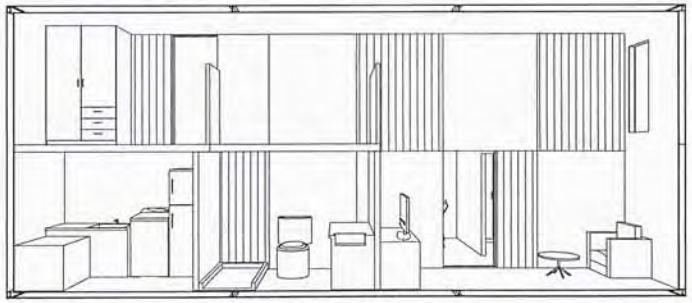

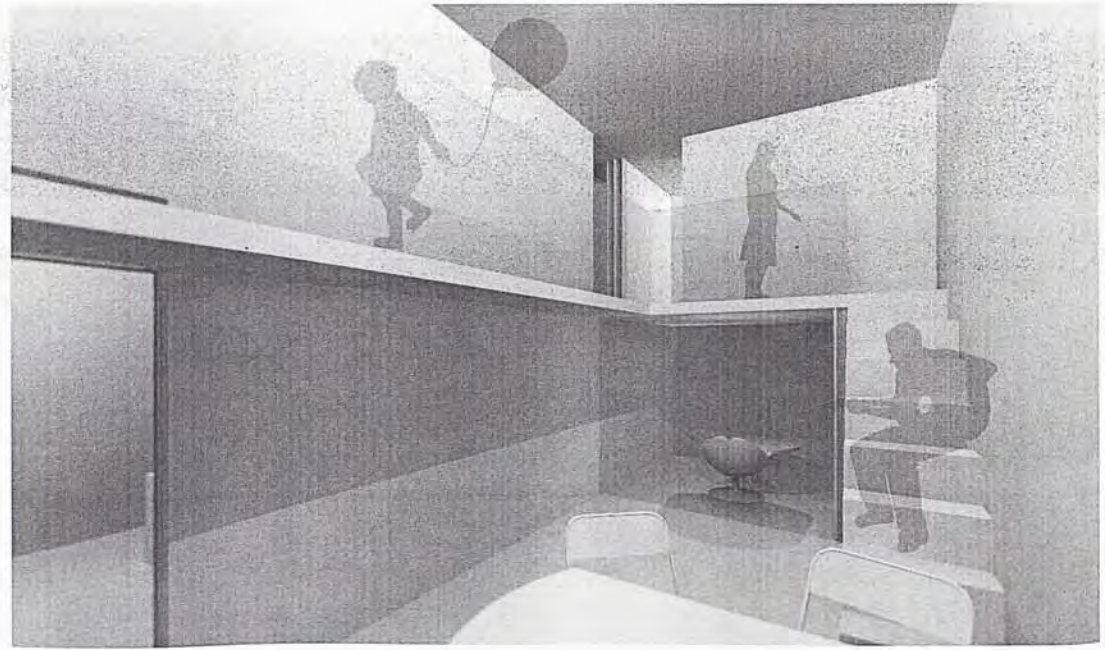

One-room compact living
– A proposal on new prototype of Hong Kong Public Housing tower and transformation of industrial building into residential use

Thesis statement:

Background

This thesis begins with the interest of some existing design system for designing dense living space e.g. Le Corbusier's "Modulor" concept and Japanese traditional housing- Tatami measurement system;

Le Corbusier develops a design system using proportional connections with human body and buildings. It is a tool to design buildings, particularly compact space which shows the importance on strong relation with human and space in it. E.g. the headroom height is determined by the height of a man with an arm upraised that is 2.1-2.2 m.

Japanese traditional housing use tatami mat which is a proportion of Japanese old mature men (L1.8m x W0.9m) to design house and rooms. They use tatami mat to understand how big a room should be. There are also rules concerning the layout of the tatami mats in a room, seating and etiquette would also be affected. The arrangement of tatami mats in the room indicates the function of it. These are some design strategies to cope with dense living space and create good quality of living space.

In Hong Kong, we experience density every day in crowded street markets, densely-packed home, caged home or looking across to rooms in other buildings. People are trying to adapt with this situation and get used to it. But no one has pointed out the aesthetic of this dense environment. Is there a system underlying this situation? How people are packed into a small unit? How to improve and appreciate small unit is also good for living? These questions and previous mentioned design strategies help me to formulate my thesis to work with dense living space.

Aim

To propose a new prototype of public housing in Hong Kong – One-room compact living concept and investigate the possibility in transforming industrial building into residential use which take the advantage of high headroom in factory.

One-room compact living concept

The idea of one-room compact living is found from early public housing. One-room means the architects only provide the structural building envelope for the users and let the interior subdivisions be free for the users to decide. So, the home provided for the residents is a single space with bathroom, kitchen and balcony these supportive rooms similar to the early Hong Kong public housing project. The advantage of one-room design is those units are small but flexible in use and adaptable to habitants' needs.

High floor height – adding mezzanine floor

Apart from taking the idea from early public housing design that is planar flexibility, this thesis introduce another idea – sectional flexibility which means a higher net floor height increase the possibility of room arrangement. Therefore, it also determines the site selection – industrial building for transformation.

Variations of unit type and plans

Prefabrication building system is adapted for this transformation so that the existing structure can be kept with plug-in units. All units are designed to be assembled as a box in factory and be transported to the site for installation. The structural framework of the unit is composed of steel columns with panels added for enclosure.

To accommodate different type of units, three types of modules with different length are proposed to combine into three types of units. The width of each module is maintained as there meters for easy transportation. The lengths of them are there meters, seven meters and nine meters to suit the deep plan of the site.

Some detailed unit plans will be designed to demonstrate how to subdivide the interior to suit different residents. Type A with an area of 36 sqm, is for a couple. It includes a mezzanine floor as bedroom and a living space with higher floor height. Type B with an area of 48 sqm, is for a family with three bedrooms. They also have a bigger balcony open to outside surrounding and indoor balcony open to the central courtyard. Type C with an area of 54 sqm, is for family with 3 generations to live together having three bedrooms.

Keywords:- compact, small scale, density, high floor height, public housing, one-room, single-building volume, industrial building, prefabrication building system

Method of research

To clarify the thesis topic, whether is to design a system for dense living or a typology and to understand the current situation in Hong Kong, public housing in Hong Kong is the focus to research. Public Housing is to provide affordable homes for people in need so that their units are rather small and compact. This type of housing shows a strong relation with human body because of its smallness.

The first research is to study different types of public housing in Hong Kong over the years. Each type of public housing has different sizes of unit plan to suit different family size. Number of inhabitant designed to be lived in is also studied and compared over the years.

During the research on the types of public housing in Hong Kong, some detailed unit floor plans are found from the annual report of Hong Kong Housing Authority. The detailed unit plans are drawn by the architects while they were designing the whole building. The plans are shown how the architects were trying to pack people into the room, techniques they use and give more information for what compact living is. These plans act as the second part of researches.

The third part of researches is to find out other international cases with similar problem in handling limited living space. Some case studies are house design, collective housing design, and furniture arrangement design.

Researches findings

01 Study of Types of Hong Kong Public Housing and Unit types

Public housing in Hong Kong can be summarized into four categories according to the years 60's, 70's, 80's and 90's onwards. Public housing in 60's are Mark series, the density is the highest among all others as the appearance of public housing is just to pack people into a safe, secure building to protect from fire hazard. Therefore, no much design concern to better living quality. But we can investigate how people are packed into the unit. The extreme case is that one person only had 2.22sqm in the design stage. In real situation, the unit can be even denser.

In 70's, the unit design is better which providing adequate balcony open space, private washroom and kitchen. These supportive rooms are not guaranteed to be provided in Mark series. The form of building is various i.e. I-shape, L-shape, H-shape and courtyard etc. Some play areas are designed around lift lobby area for promoting inhabitants' communication.

In 80's, the unit design starts to change from one-room design into flat design. The units have been subdivided into different function rooms i.e. bedroom, living room, and dining room. This design concept helps to organize the unit and formulate the dimension of each unit types but limit the changeable use by the inhabitants. In 90's, they

also further introduced standardized unit concept using room module I.e 1-bedroom, 2-nedroom and 3-bedroom to compose different units.

One-room design? Flat design?
From the first research, although the living standard has been increased, people can enjoy more space in public housing unit, the flexible use of units in the past is lost. So the thesis topic is set to design one-room compact living and find out how to provide good spatial experience in this kind of dense living.

02 Study of Detailed Unit Plan

The second part of researches is to understand how compact the living space it is and how inhabitants were trying to cope with the situation in one-room compact living space. Through the isometric drawings and plan, we can understand how the inhabitants to put wooden partition wall and furniture to define their functions rooms. Their strategies to cope with limited spaces are:-
Use of rather large-sized furniture as space defining elements
e.g. high wardrobe, moveable or fixed light wooden partition wall instead of fixed concrete partition wall
Use of mutli-proposed furniture
e.g. combination with bed, study table and wardrobe
Use of foldable furniture
e.g. dining table, chair, bed and sofa transformed into bed at night-time

As these detailed unit plans are drawn by the architects while they were designing the whole building, we can see sometimes the architects cannot even arrange enough space for all designated people to live in. A foldable nylon bed is meant to be some kind of private space only at night time. Or a single-sized bunk bed with the hanging curtain wrapped is meant to be bedroom. A dining table can be a study table for children after school. Everything is changeable, transformable and flexible. No one complains how small they live in rather make good use of the space.

03 Precedent studies of compact living

The third part of researches is to find out other international cases with similar problem in handling limited living space. Case studies are house design, collective housing design, and furniture arrangement design.

03.1 House design

Le Petit Cabanon by Le Corbusier 1951-52 in Roquebrune-Cap-Martin, France
In 1951, Le Corbusier built a summerhouse in the south of France for his wife, calling it a cabanon (Le Petit Cabanon, Roquebrune-Cap-Martin). It faces the Mediterranean Sea next to the Etoile de Mer bar-restaurant that the couple visited each summer.
The building is a square, measuring 3.66 meters in each direction with ceiling height 2.26m based upon the 1.83m height of the "ideal man" with an upraised arm. It is also equal in size to an eight-tatami-mat room. This space was based on his modular scale, which implements the golden section and measurements derived from the human body.
Inside, there were two beds, a small table and the minimum necessary storage, toilet and small basin. There was no kitchen because he could eat at the restaurant next door.
It is an extremely small space and an investigation

of minimal dwelling space.

03.2 Collective Housing design
Urban Tulou by Urbanus 2008in Guangdong,China
Urban Tulou is an affordable housing for China. The design is inspired by the traditional vernacular form of Tulou. Tulou is a unique dwelling type to the Hakka people.
Units in traditional Tulou are laid out along its perimeter. Tulou helps to insulate the users from outside nosie and create internal space.
The units typically are 30sqm for two couples with maximum five people to live together. This unit includes living room, two bedrooms, kitchen, washroom and balcony. Some programmes happen in overlapped space so as to minimize the area needed but ensure all functions are included. For example, an open kitchen is placed next to the corridor so that no partition wall is needed and eliminates the area for building partition wall.

03.3 Collective Housing design
Old Hong Kong Police Housing Quarters 1951 in Hollywood Quarters, Hollywood Road, Hong Kong
In 1950, the Hong Kong Government launched a housing programme for all serving and married officers of the rank and file of the Hong Kong police. It is no doubt that this programme was of great importance in the history of Hong Kong police force. It also marked one of the highest achievements in Hong Kong modern architecture.
There are two unique housing types developed through this programme. Built in 1951, the first Hollywood Road Quarters is a "multi-storey type". It features a public corridor separating the kitchen and an open space from the main unit. We believe that this type had a great influence on the later large-scale public housing development in Hong Kong.

03.4 Collective Housing design
High-efficient space residential design by Bao Jiasheng 1992 in China
The residential design uses the concept of "Support House" which defines two elements – structural and space defining elements. Structural element means the unit enclosure as structural support while space defining element is light-weighted partition wall or furniture. Because of the separation of structural supports with interior wall, flexible subdivision inside the unit is possible and produces more flexibility.
The net floor height of each room design increase from 2.7-2.8m normal height to 3.4m high. This promotes idea of loft space as bedroom space above the kitchen, washroom area or furniture e.g. bed, shelf, sofa etc. The floor height of lower level is 2m high, the upper one that is bedroom is 1.4m high. The increase of floor height by 20%-30% can increase the usable floor area much more.

03.5 Suitcase concept – House design
Suitcase house by Gary Chang 2006 in The Commune By the Great Wall, Shuiguan, Badaling, The Great Wall, Beijing
Suitcase house is located at the head of the Nangou Valley near the Great Wall at Badaling, North of Beijing. The site slopes steeply towards the north and relatively exposes. To maximize the view and solar exposure, the house is in north-south orientation. In the house, it is possible to see all views of the Great Wall. The house provides with multiple entrances, all with equal status, while each room is differentiated by the provision of unique amenities.
Suitcase house is a stiff, flat-sided case for carrying ones personal items when one is travelling. This design attempts to rethink the nature of intimacy, privacy, spontaneity and flexibility. It demonstrated the desire for ultimate adaptability, in pursuit of a proscenium for infinite scenarios.

03.6 Suitcase concept – Collective House design
My 32sqm apartment by Gary Chang 2007. A tenement building along the Victoria Habour near Swire dockyard in Hong Kong
The apartment is now Gary Change is living in, he has lived in this seventh floor apartment when he was 14. At that time, he and his parents and three younger sisters were all lived together in this room. Using sliding wall units suspended from steel tracks in the ceiling, this room becomes many different spaces – kitchen, library, laundry room, dressing room etc. It is a room can be transformed into 24 different room configurations.
A hydraulic foldable bed hides behind a sofa during the day time. Beyond a CD wall is a washer-dryer nook and a wall for the TV. A panel hides the washer-dryer nook and the TV wall moves to reveal the kitchen. Behind one movable wall of shelving is an extra-large bathtub. A glass shower stall doubles as a steam room with color therapy and massage.

03.7 Furniture arrangement – House in a suitcase
House in a suitcase by Eva Prats and Ricardo Flores with Frank Stahi 2001 in Barcelona, Spain
House in a suitcase is a temporary home located on the roof of a Barcelona apartment building. It is a single-roomed space measures 3 x 3 x 9metres with a small shower room at one side. This is a hotel room and also an apartment when it unpacks

when occupied. There are two plywood boxes – kitchen box and bedroom furniture disassembles to reveal living space. The kitchen box is 6.5 feet long by 5.5 feet wide by 4 feet tall/ it hides a stainless steel sink, hinged shelf and fold-out table etc. The bedroom furniture is slightly larger box than the kitchen one. It includes a double bed sliding out from the living area platform, the closet's door convert into a folding screen shading the dressing area.

03.8 Furniture arrangement –High-efficient space workshop design
High-efficient space workshop design by Bao Jiasheng 1998 Center of Open Building Research And Development, School of Architecture, Southeast University, China
This workshop is originally housed 8 people for working there, there were 8 desks and a common table in the center. However, in later stage, there are more and more people working together and need for refurbishment. Therefore, a table module is designed to maximize the vertical space while creating two levels for placing desks. At the same time, some storage space is also created. The useable floor area is increased by 200%. This is one of the great examples showing how to maximize the use of vertical space.

Design strategy extracted from researches
One-room space
The idea of one-room compact living found from early public housing is used as the start point to design housing unit. As the structure is the unit envelope, more possibility is seen to be done. While the idea of flat space, structural wall is used to subdivide the internal space. It minimizes the possibility. Supportive rooms like bathroom, kitchen and balcony which are also provided in early public housing would be included for further design exploration.

Regular shape
Apart from one-room space idea, the shape of this one-room space should be in rectangular shape for more possible subdivisions. Irregular shape limits the subdivisions as it already determined rooms' arrangements by its shape.

High floor height – mezzanine floor
Increasing net floor height by 20-30%, it can be created mezzanine floor for storage or bedroom space. From the mentioned case studies, the usable floor area can be increased up to 200%. This is one of the major elements in design compact living space.

Site research
The site should have higher net floor height than normal residential buildings for design experimentation. From selection of existing buildings in Hong Kong, only industrial buildings have higher net floor height. Several types of factory building have been considered as site. They are government-owned factory building and different industrial zones in Hong Kong like Tsuen Wan, Tai Kok Tsui, Fo Tan etc. Industrial zones with surrounding residential building would also be considered as it shows there is a tendency in transforming industrial zone into residential uses.

Factory Building
Only former Shek Kip Mei (Now JCCAC), Chai Wan and Kowloon Bay factory Building are still existing. Others have been demolished for other redevelopment.

The design of these buildings are divided into "H type" and "I type". 7-storey "H type" design which similar with the first resettlement blocks, has two wings and uses public toilets and bathrooms to be located between the two wings for connection. "I Type "is a single-block design, with public toilets at the both end of the wings. However, all government owned factory buildings do not have enough high floor height for design experimentation.
Until 1973, the Housing Authority took over the former Resettlement Department of the eight resettlement factory buildings, and in 1973 to 1984, more than 9 factory buildings were built, floors has increased from 7 to 20 multi-storey , and building design would be changed according to the site condition.

Industrial building in Hong Kong

01 Fo Tan

This industrial area is located close to East Rail Fo Tan station and is separated from the nearest residential developments by roads. Planning Department has been advised to rezone a site south of Au Pui Wan Street into comprehensive residential development and commercial development. This site is close to railway station and can be optimize its use as its adjacent site has been rezoned into composite development areas. This site can be as a starting point in transforming the whole Fo Tan area into residential uses.

Some Artist studios in Fo Tan have been visited to study the net floor height and how the artists organize their space whether if they have made loft space / mezzanine floor in maxizing space and increase space efficiency.

02 Tsuen Wan East

This industrial area is located close to Southwest Kwai Chung. There are some recently completed residential and commercial redevelopments in the surroundings. Planning Department has been advised to rezone part of this area into comprehensive residential development with provision of commercial facilities and open space. Some industrial buildings with higher net floor height can also be found.

03 Tai Kok Tsui

Industrial buildings in Tai Kok Tsui are scattered widely in the district which is now predominantly residential uses. However, the floor plates area of industrial building area less than 450sqm which is rather small scale for this design experimentation.

With consideration of high headroom factory building and surrounding condition, Fo Tan would be chosen as site for design experimentation.

Term 2

The site – Fo Tan

With consideration of high headroom factory building and surrounding condition, Fo Tan would be chosen as site for design experimentation.

The Building – Unison Industrial Centre

This building is selected as the site for design experimentation because it is in the rezoned site proposed by Planning Department for transforming into residential area.

Other than the above advantage, the specific characteristics of this building (geographical location, structural system, spacious quality of space, high net floor height) show the potential for transformation. The building is close to East Rail Fo Tan Station and is next to an open area, now is a car park which the land is belonged to the government. The surrounding land lots are proposed to be rezone into residential or commercial redevelopment so that it is a chance to foresee the redevelopment in Fo Tan. The structural system of this building is different from the typical industrial building. It uses flat beam with the depth of 550mm to maintain higher floor height and the structural grid is as large as 1000mm x 1000mm.

Year of Completion: 1982
Site Location: 27-31 Au Pui Wan Street, Fo Tan
Site Area: 3000sqm
Total number of storey: 17
(G/F – 3/F Podium, 4/F-16/F Tower)

Current Use:
G/F Main Entrance/ Commercial Use
1/F Car park
2/F Office/ Factory/ Warehouse
3/F Podium/ Office/ Factory/ Warehouse
4/F – 16/F Office/ Factory/ Warehouse

Floor to Floor Height:
G/F 5230mm
1/F 4400mm
2/F 4750mm
3/F 4800mm
4/F – 16/F 4800mm

Design Investigation

Design strategy extracted from researches

The design strategies extracted from the researches are One-room unit space, Regular shape of the unit and high floor height for adding mezzanine floors. One-room unit space proposes the flexibility and possibility for different interior subdivision. Regular shape enhances more choices in subdivision. High floor height creates various spatial experiences and maximizes the use of floor area.

Mass Study of Units –
Transformation from Harmony Type of Units

The design begins with the analysis of the existing types of units in the latest existing Hong Kong Public Housing – Harmony Type. There are three types of units to accommodate different size of households. They are 1-bedroom type, 2-bedroom and 3-bedroom types. The area of these three types is 40sqm, 50sqm and 60sqm.

The first mass study is to propose other size of units while maintaining the same volume with reference to the Harmony types. The proposed new units' areas are 27sqm, 34sqm and 41 sqm with the floor height 4000mm so that the volume of each unit can be maintained as same. Narrow type, wide type and linear shape of units are proposed. However, to adapt to the deep plan of industrial building, another size of units are proposed. The widths of units are maintained as 3000mm so as to maximize the number of units which can be inserted into the factory. These sizes of units also propose the prefabrication building system for the transformation of factory. The existing structural system is maintained with plug in units added.

Three types of modules to form three type of unit are proposed. The width of each module is maintained as 3000mm for easy transportation. The lengths of them are 3000mm, 7000mm and 9000mm to suit different type of units. All units are designed to be assembled as a box in factory and be transported to the site for installation. The structural framework of the unit is composed of steel column with panels added for enclosure.

Mass Study –
Form, Layout and Number of units

After decided the size of three units, different typical layout plans and unit distribution are formulated. There are four types of building form:- courtyard type, C-shape tower, U-shaped tower and small courtyard type. With keeping or removing the existing lift core and car lift core, creating single-loaded or double loaded corridors, different layout plans and number of units can be found. The maximum case of inserting the most number of units – 46 is courtyard type with double-loaded corridor. The existing lift core in the central area is needed to be removed. The least case is U-shape tower with only 31 units can be occupied. These studies help to understand how to revitalize and maximize the use of factory building and how the form of building would be changed.

Final design

Grouping on every three floors

In fact, the optimal layout plan is courtyard type which would provide sufficient direct sunlight and ventilation to tackle the common problem of deep plan in factory building. However, with the consideration of maximizing the use of existing floor area and putting as many number of units as possible, C-shape and U-shape floor plans are adapted. The existing lift core can also be kept while transformation. C-shape and U-shape floor plans provide an opening to outsides on the original square-like floor plan. It helps to form a gathering space and allow sunlight entering the tower. Three different direction of openings are proposed so as to create variations of internal gathering space and allow different time and angle of sunlight entering the tower. Therefore, grouping on every three floors is proposed and repeated to form the whole building. There is a central courtyard connecting all floors while internal staircases promote connection between gathering space on every floor. There are also some internal high floor height space with 3-storey high to create different spatial experience.

Layout plan

There are three types of units to accommodate different size of household. The number of Unit Type A is 10, Unit Type B is 8 and Unit Type C is 4 on every floor. The ratio of number of units on every floor in Harmony type is 1:3.5:4.5 and the total number of units on each floor are 18. Keeping the same ratio as the Harmony type to design an alternative floor plan is tested but do not suit to the site. It would reduce the number of units that can be put on each floor plan. Therefore, the new ratio for this factory plan is 1:2:2.5 and total number of units on each floor is 22.

Detailed Unit plan

Unit Type A is designed for 1-3 persons, Unit Type B is for 3-5 persons and Unit Type C is for 6 persons or above. This standard is as same as the allocation standard of Harmony type.

Unit Type A is composed of Module A – 3x3 m and Module B – 3x7m. Unit Type B is composed of Module B – 3x7mand Module C – 3x9m. Unit Type C is composed of two numbers of Module C – 3x9m. Therefore, the size of each unit is standardized.

Some detailed unit plans are designed to demonstrate how to subdivide the interior to suit different residents. Unit Type A with an area of 36 sqm, is for a couple. It includes a mezzanine floor as a bedroom and a living space with higher floor height. Type B with an area of 48 sqm, is for a family with three bedrooms. One of the bedrooms is for a couple and two bedrooms with single bed are for their children. They also have a bigger balcony open to outside surrounding and indoor balcony open to the central courtyard. Type C with an area of 54 sqm, is for family with three generations to live together having three bedrooms. There are two bedrooms with double bed and a bedroom for their grandchild.

Variations of room composition of each unit type

Variations of room composition of each unit type are generally designed to demonstrate the flexibility of unit plan. Unit Type A which proposes for small family with 1 bedroom can also be designed and subdivided into 4 bedrooms in the extreme case. Therefore, it can be just a studio flat design but also can be transformed into a very compact use. Unit Type B is proposed to provide 1 to 2 bedrooms can be maximized into a home with 5 bedrooms. Unit Type C is proposed to provide 2-3 bedrooms can be maximized into a home with 6 bedrooms. Although the spatial quality would be worse in the extreme case with only 2m high headroom, some precedent studies in China has been shown that the residents still quite satisfy with this design method.

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